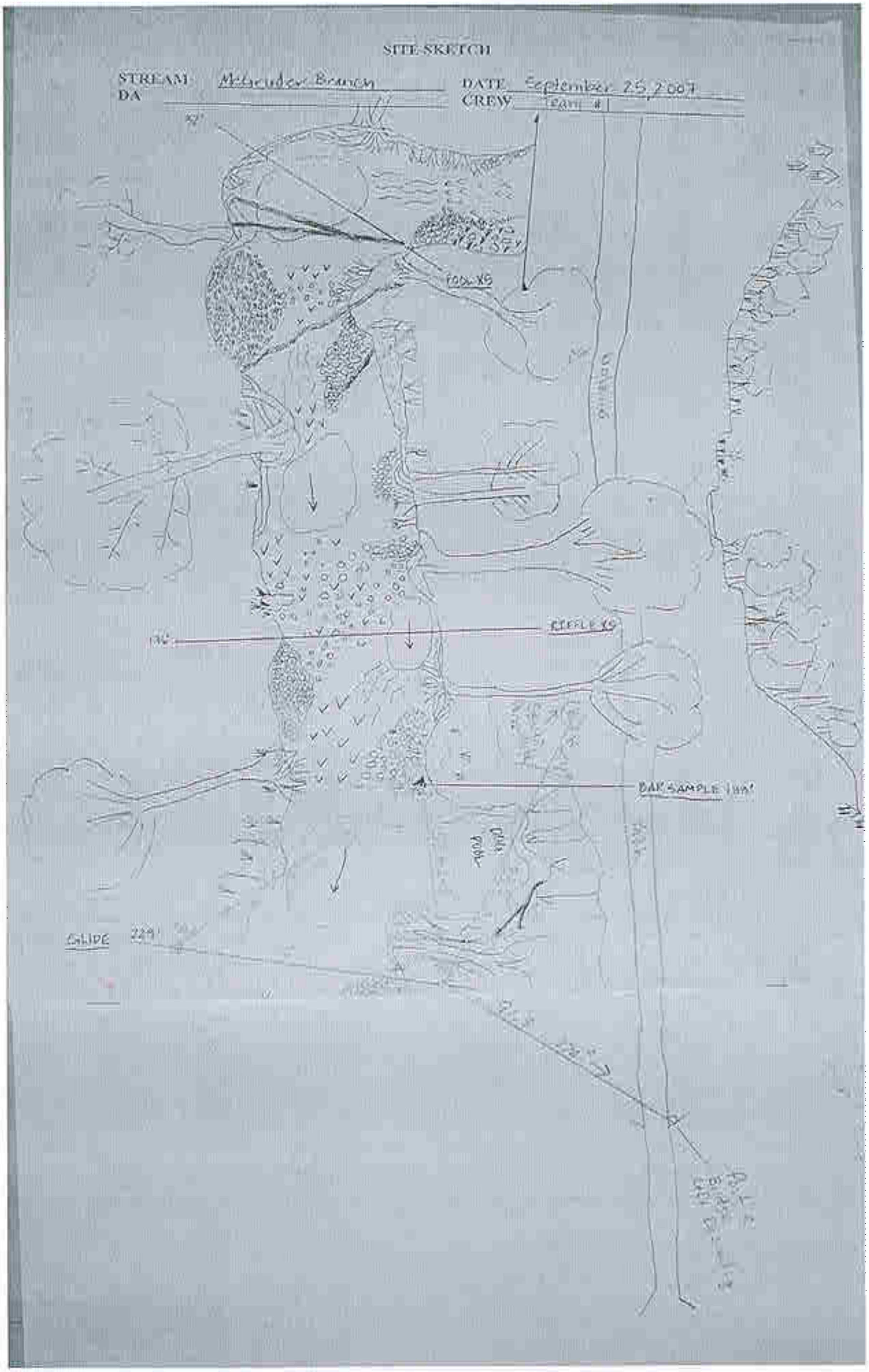
River Assessment and Monitoring
NCTC - Shepherdstown, WV
9/17 – 9/27/2007

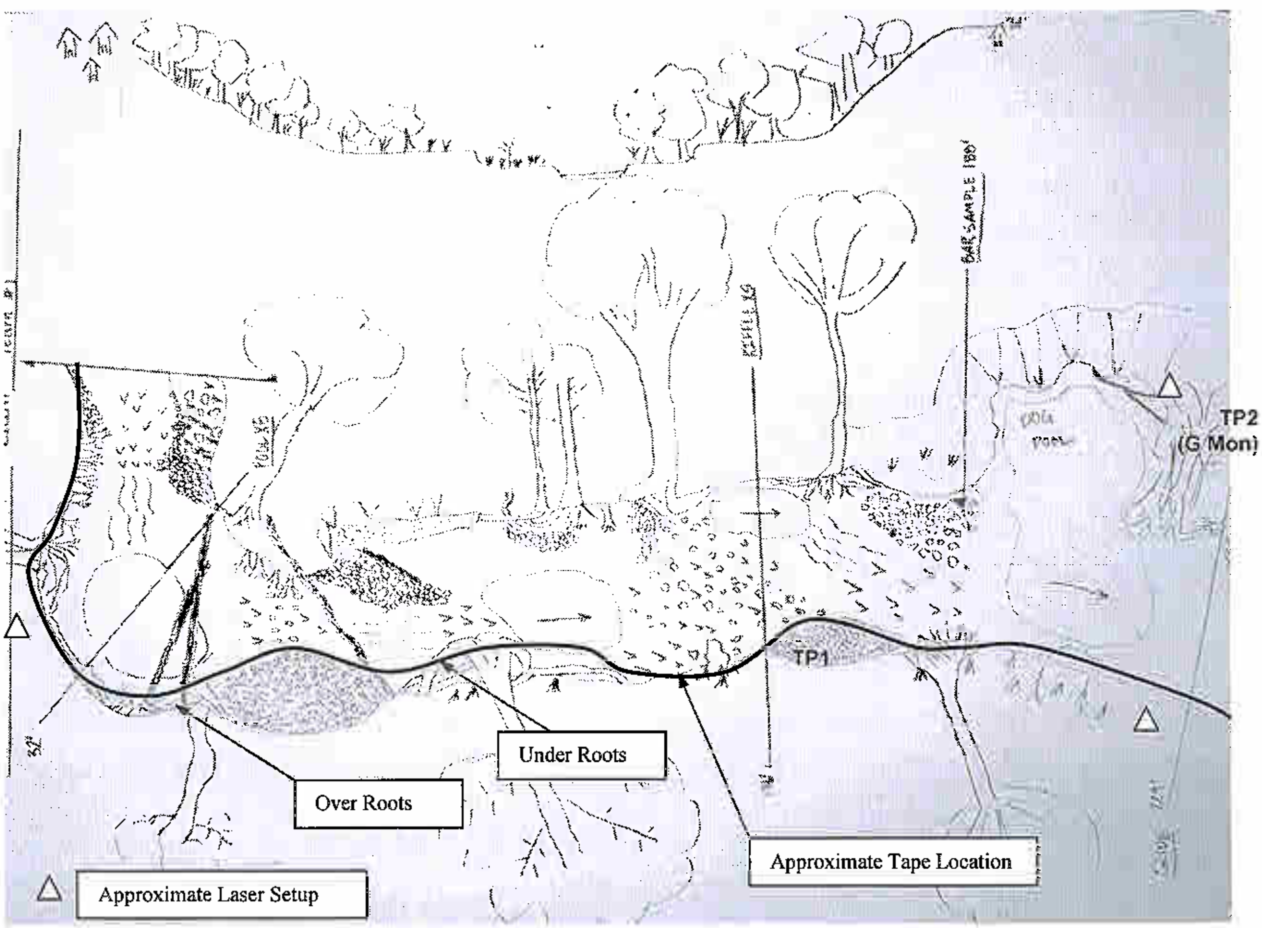
Team 1
Day 3
Magruder Branch
Degraded Reach

Magruder Branch Degraded Reach Team 1 9/25/2007



Longitudinal Profile Notes

- Tape was placed along the right low flow channel bank.
  - Tape was placed up and over large tree near approx. station 50
  - Tape was placed under the exposed roots of the tree upstream of the riffle cross section (shown on geomorphic sketch).
- Utilized three (3) turning points
  - First turn was made off of an entrained rock downstream of the riffle cross section
  - Second turn was made off of the left monument station of the glide cross section



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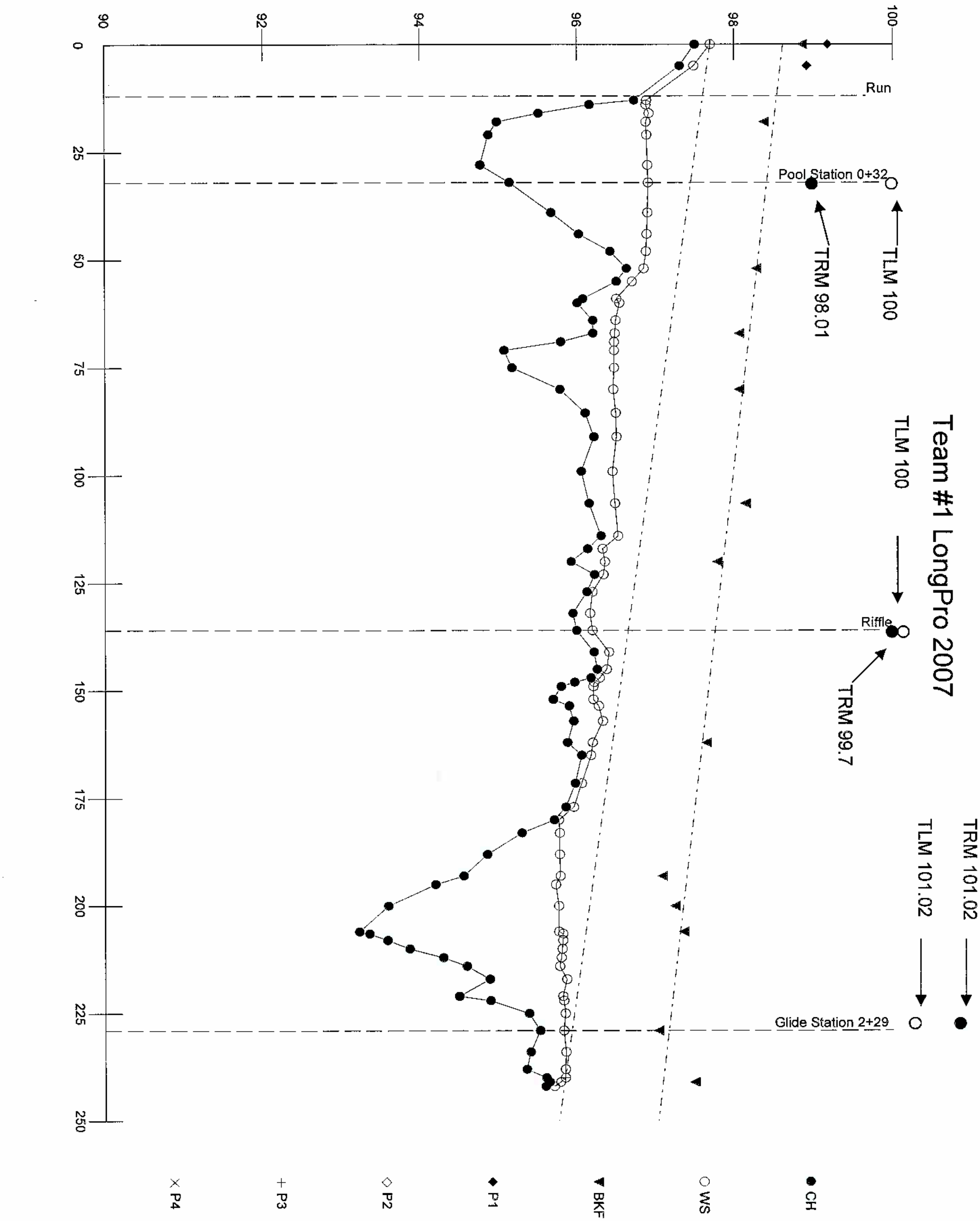

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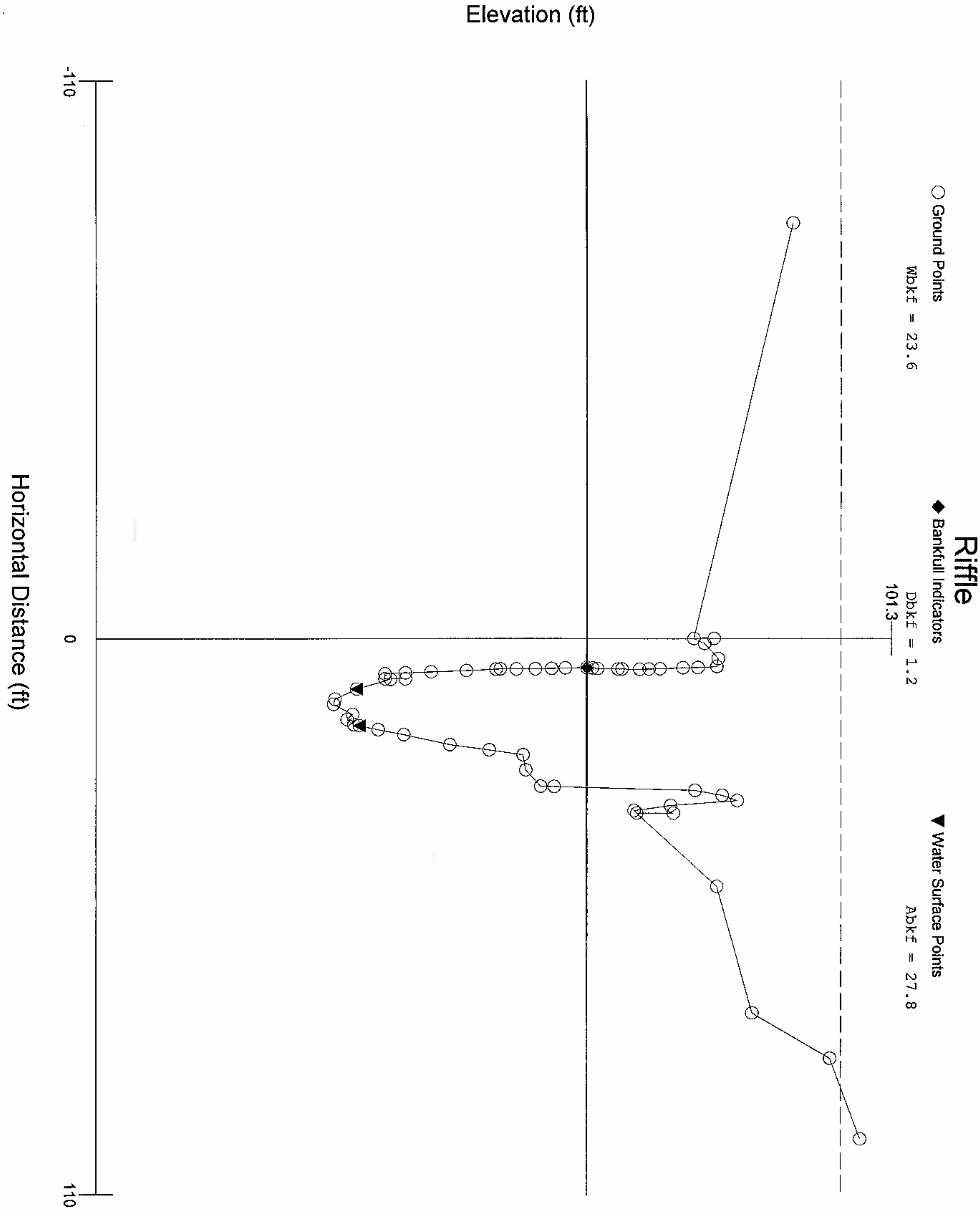
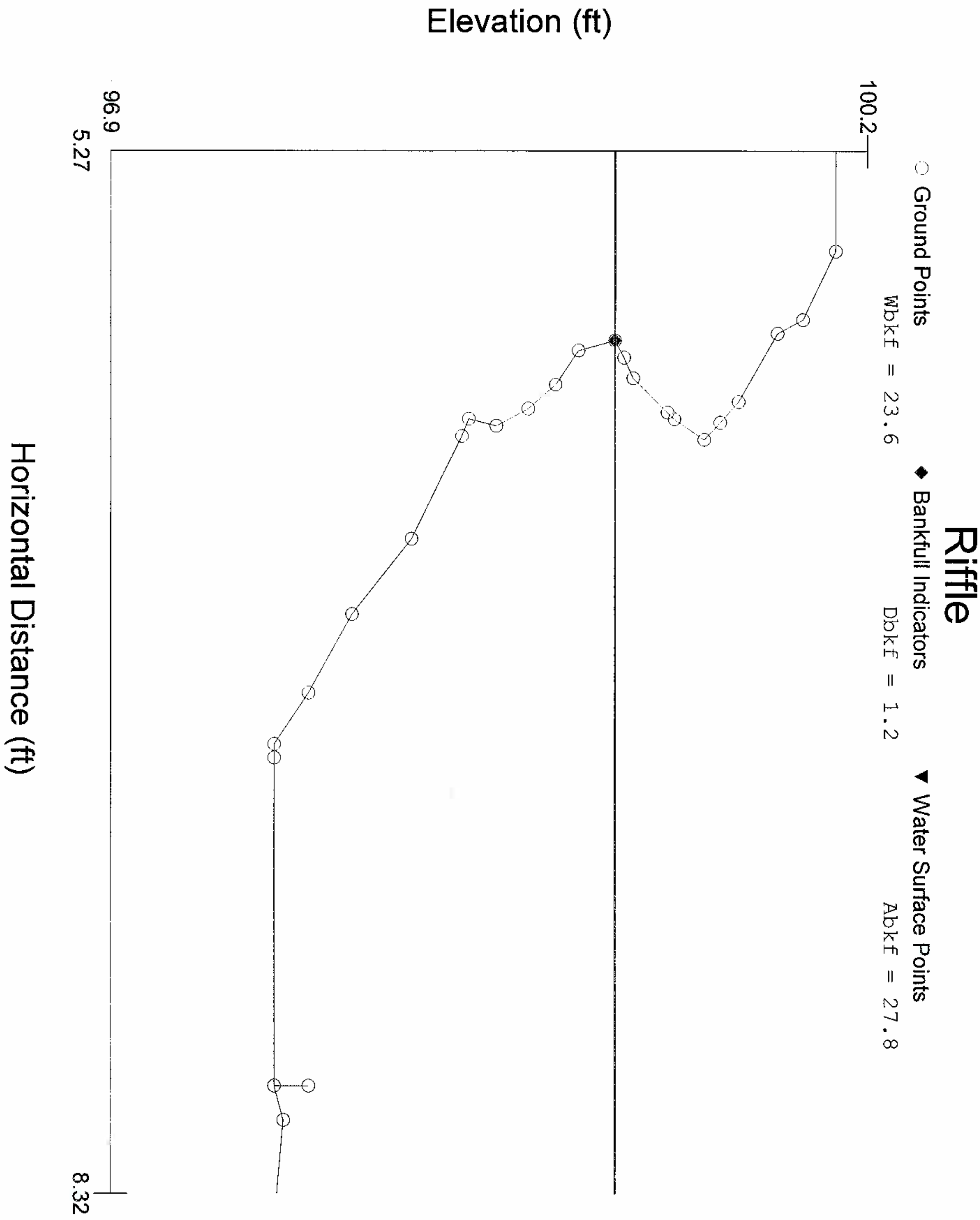
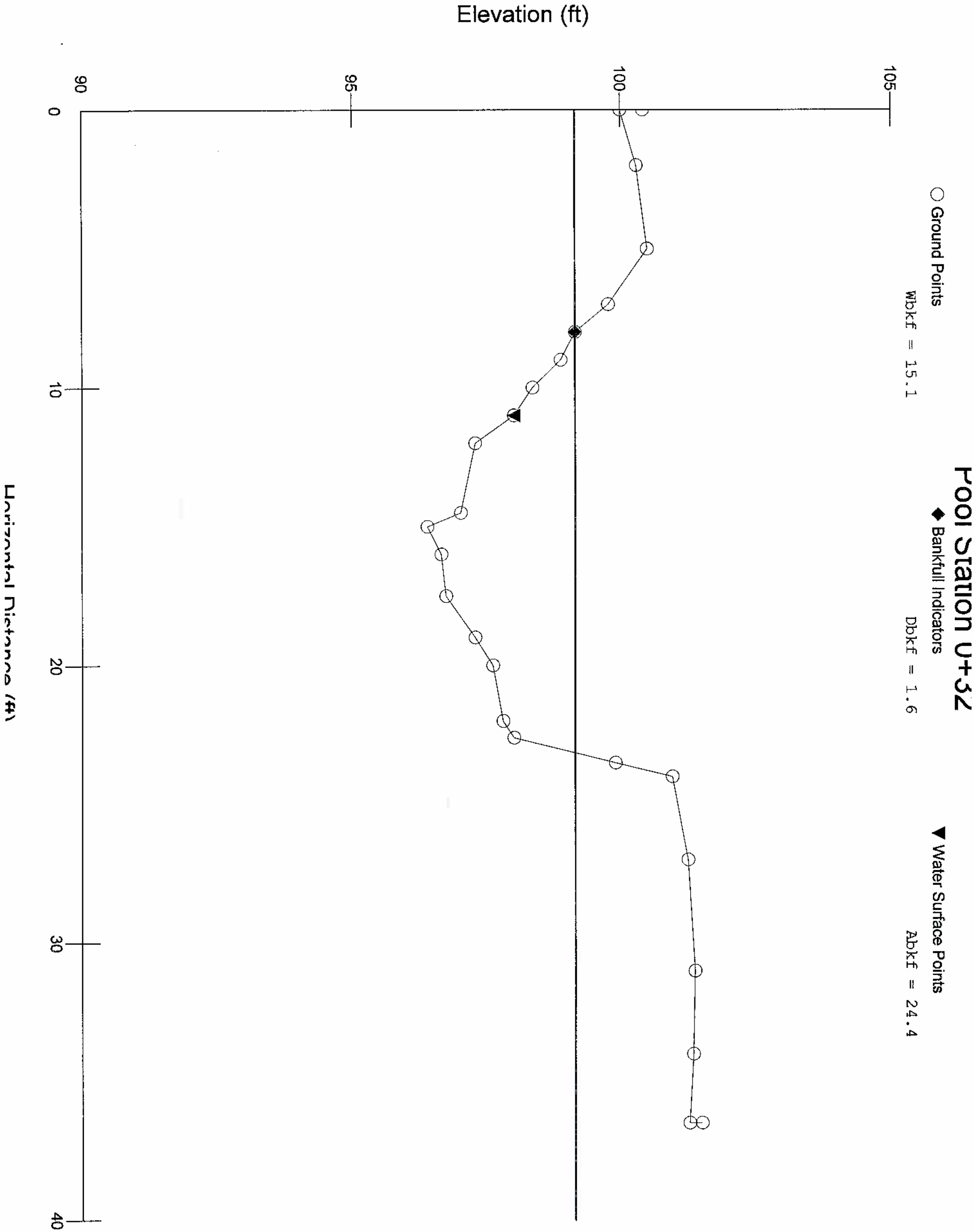
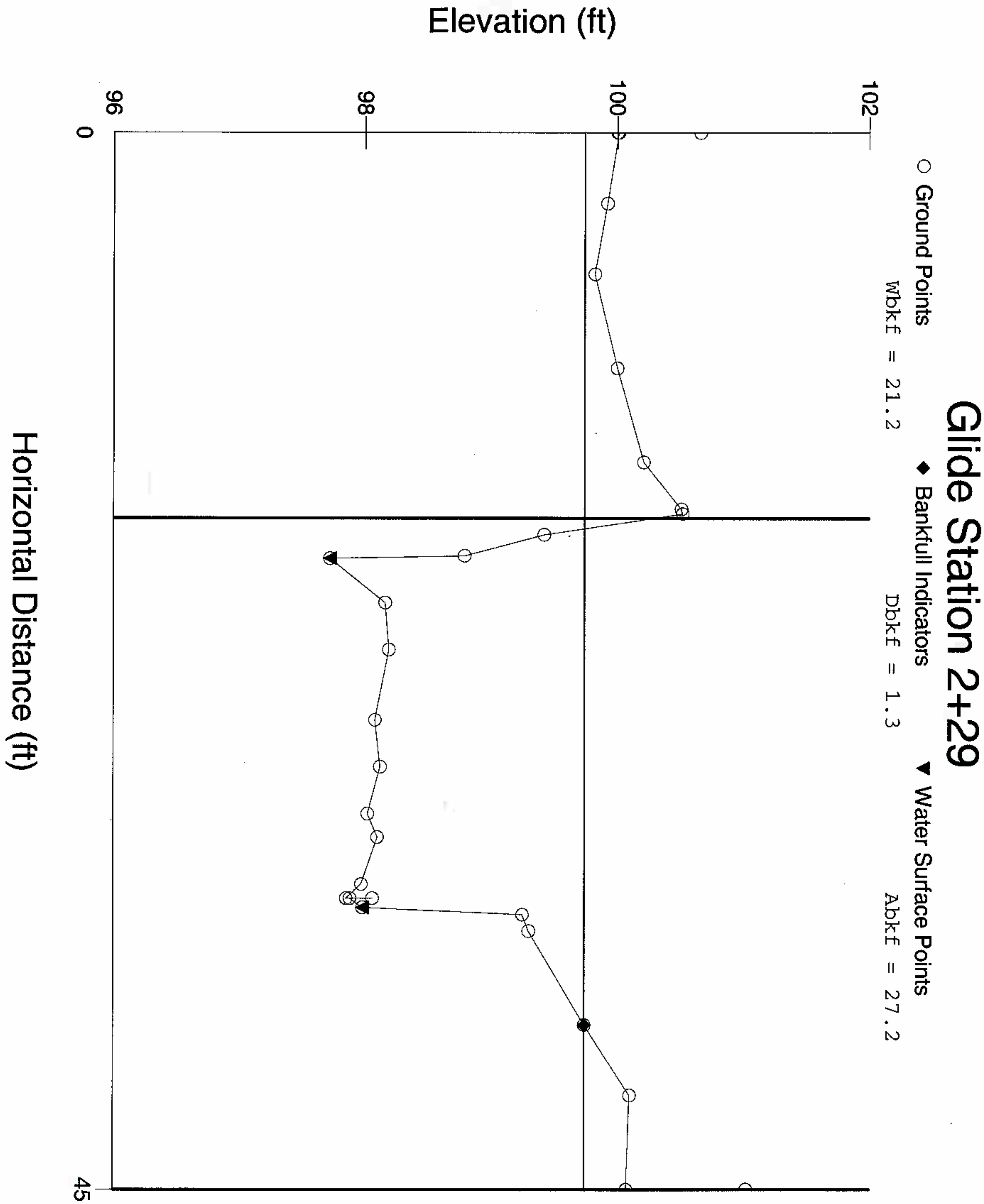



Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 23.6
Dbkf = 1.2
Abkf = 27.8
Elevation (ft)
100.2
96.9
5.27
8.32
Horizontal Distance (ft)


Elevation (ft)
Pool Station 0+32
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 15.1
Dbkf = 1.6
Abkf = 24.4
90
95
100
105
0
10
20
30
40
Horizontal Distance (ft)


Glide Station 2+29
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 21.2
Dbkf = 1.3
Abkf = 27.2
Elevation (ft)
102
100
98
96
Horizontal Distance (ft)
0
45

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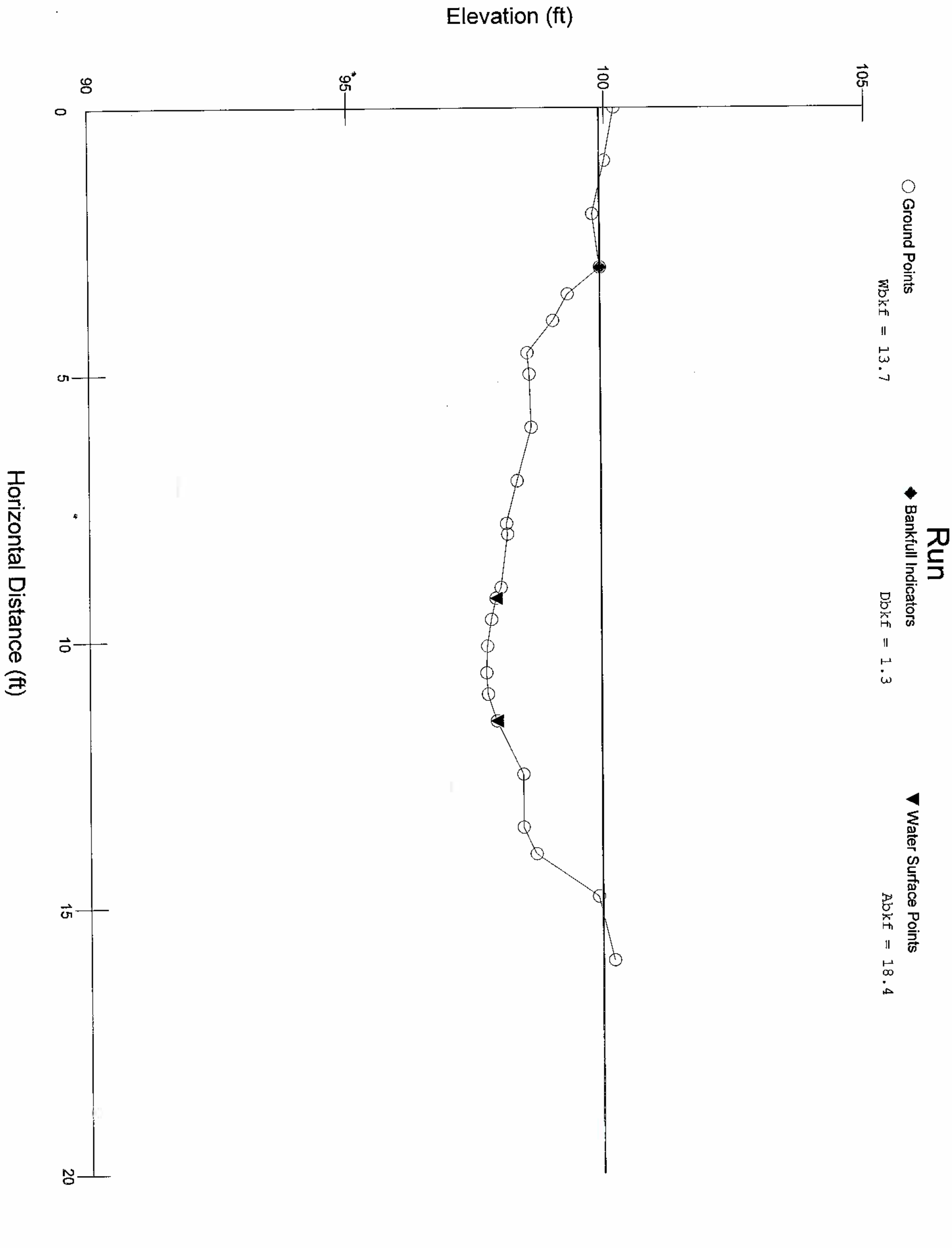

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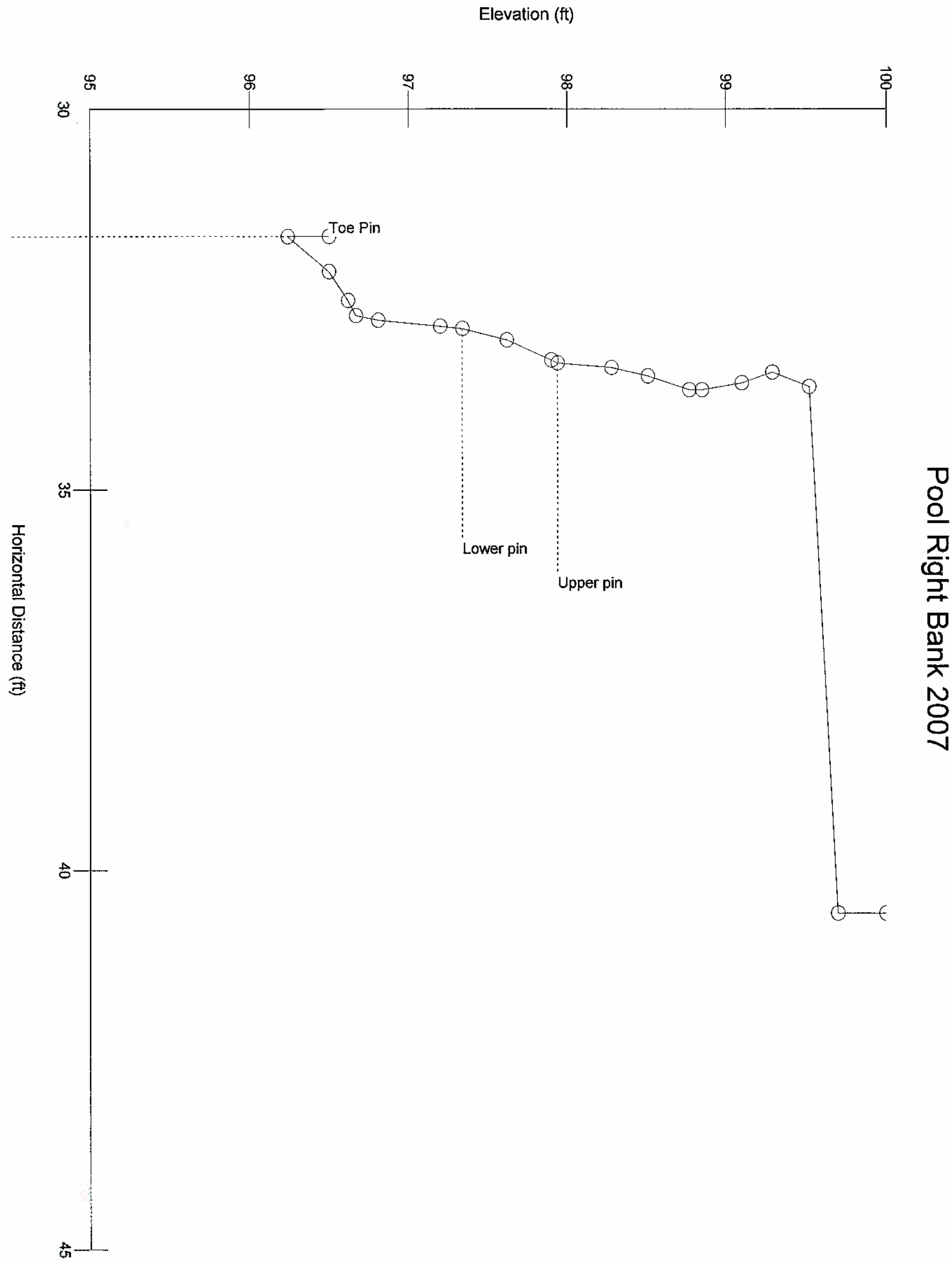

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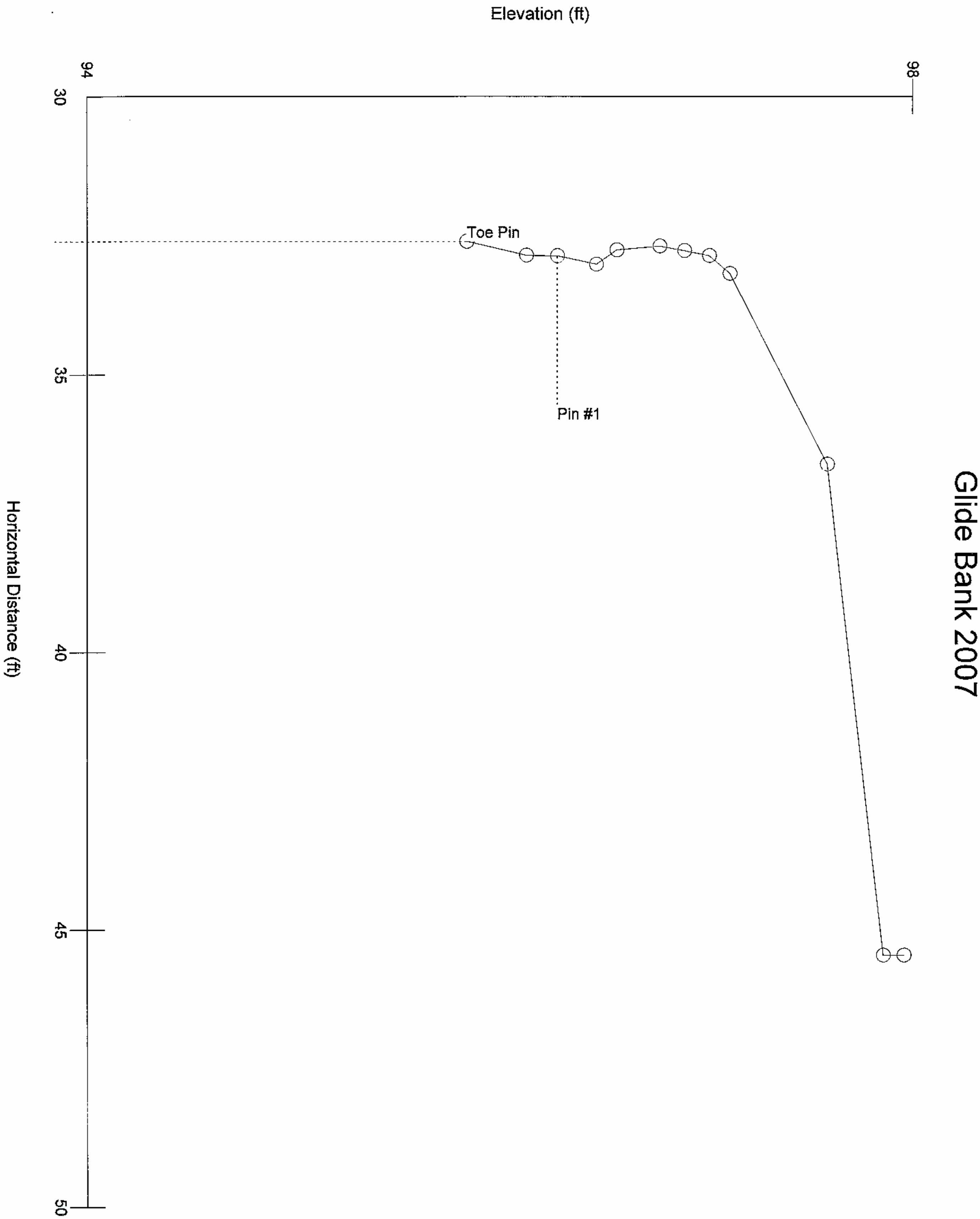

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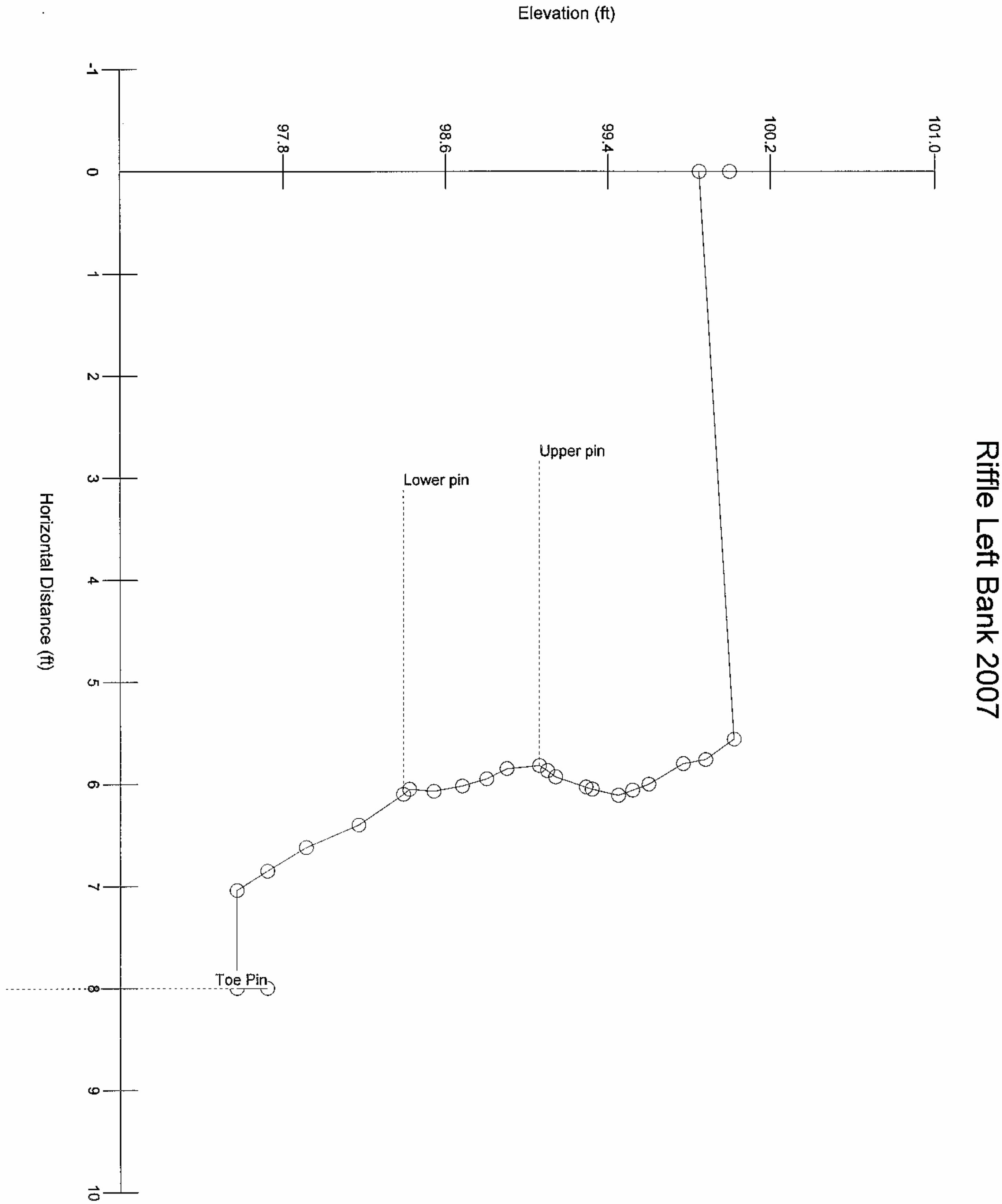
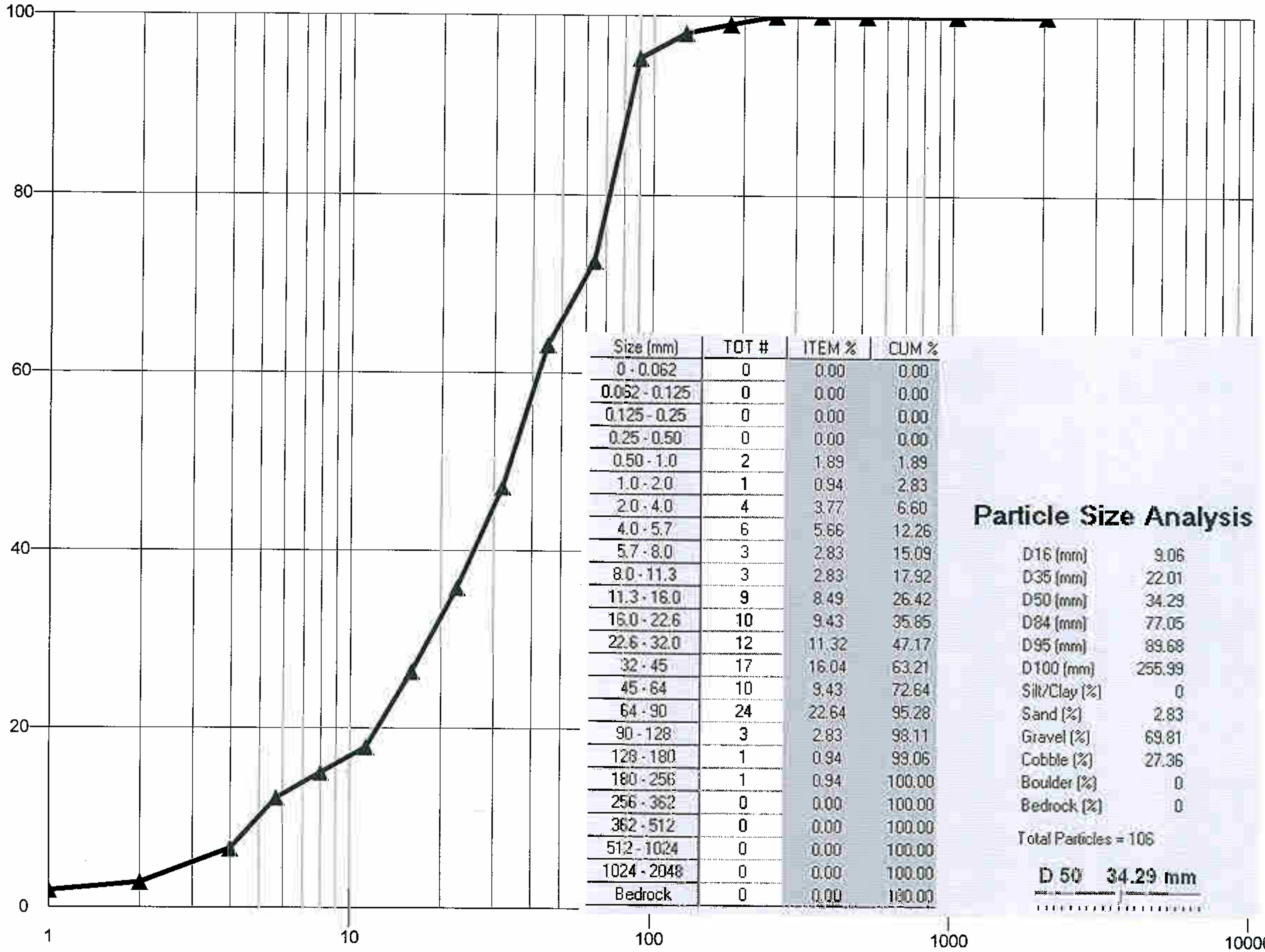


Active Channel



Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	2	1.89	1.89
1.0 - 2.0	1	0.94	2.83
2.0 - 4.0	4	3.77	6.60
4.0 - 5.7	6	5.66	12.26
5.7 - 8.0	3	2.83	15.09
8.0 - 11.3	3	2.83	17.92
11.3 - 16.0	9	8.49	26.42
16.0 - 22.6	10	9.43	35.85
22.6 - 32.0	12	11.32	47.17
32 - 45	17	16.04	63.21
45 - 64	10	9.43	72.64
64 - 90	24	22.64	95.28
90 - 128	3	2.83	98.11
128 - 180	1	0.94	99.06
180 - 256	1	0.94	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

Particle Size Analysis

D16 (mm)	9.06
D35 (mm)	22.01
D50 (mm)	34.29
D84 (mm)	77.05
D95 (mm)	89.68
D100 (mm)	255.99
Silt/Clay (%)	0
Sand (%)	2.83
Gravel (%)	69.81
Cobble (%)	27.36
Boulder (%)	0
Bedrock (%)	0

Total Particles = 106

D 50 34.29 mm

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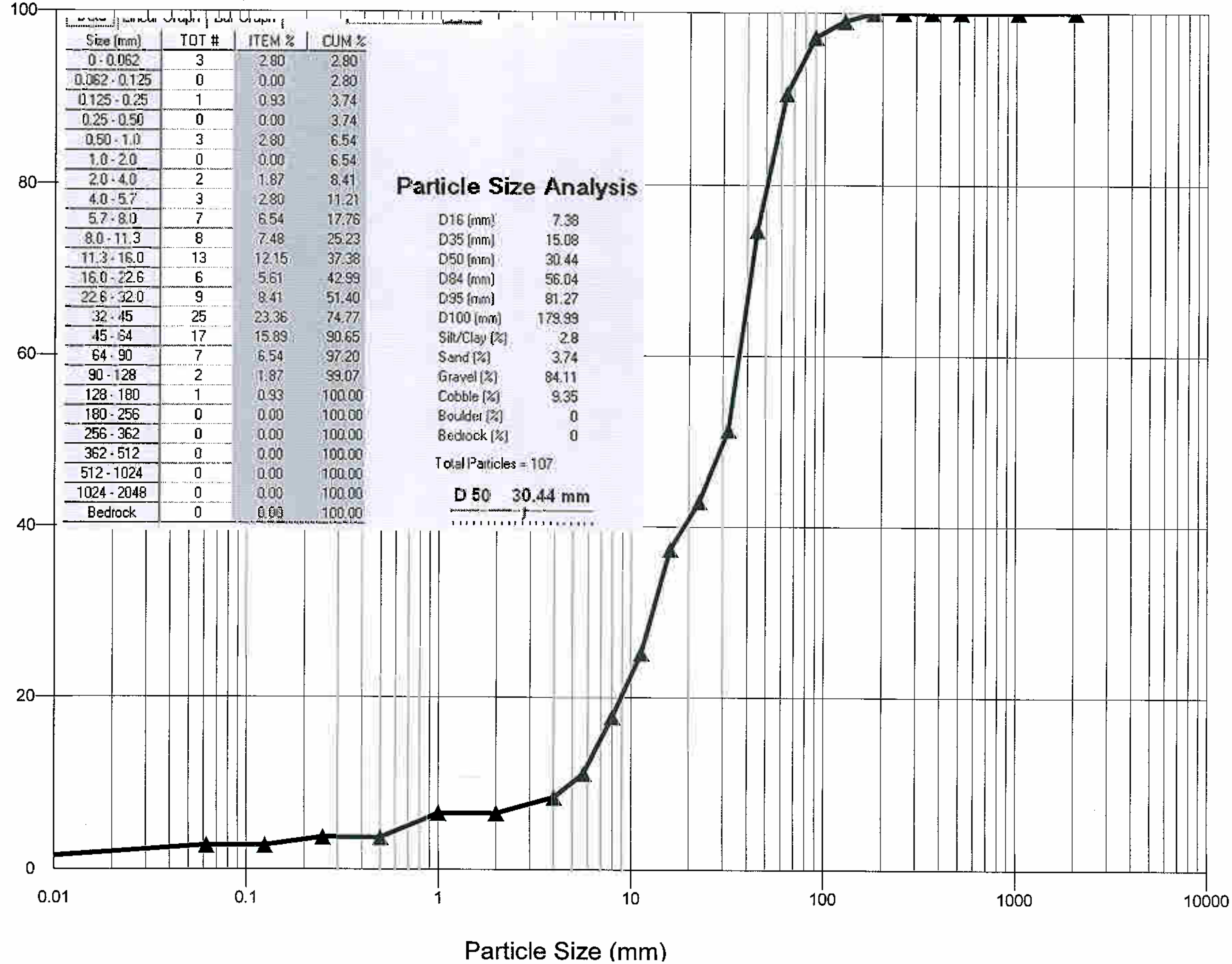
Riffle



Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	2.80	2.80
0.062 - 0.125	0	0.00	2.80
0.125 - 0.25	1	0.93	3.74
0.25 - 0.50	0	0.00	3.74
0.50 - 1.0	3	2.80	6.54
1.0 - 2.0	0	0.00	6.54
2.0 - 4.0	2	1.87	8.41
4.0 - 5.7	3	2.80	11.21
5.7 - 8.0	7	6.54	17.76
8.0 - 11.3	8	7.48	25.23
11.3 - 16.0	13	12.15	37.38
16.0 - 22.6	6	5.61	42.99
22.6 - 32.0	9	8.41	51.40
32 - 45	25	23.36	74.77
45 - 64	17	15.89	90.65
64 - 90	7	6.54	97.20
90 - 128	2	1.87	99.07
128 - 180	1	0.93	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

Particle Size Analysis

D16 (mm)	7.38
D35 (mm)	15.08
D50 (mm)	30.44
D84 (mm)	56.04
D95 (mm)	81.27
D100 (mm)	179.99
Silt/Clay (%)	2.8
Sand (%)	3.74
Gravel (%)	84.11
Cobble (%)	9.35
Boulder (%)	0
Bedrock (%)	0

Total Particles = 107

D 50   30.44 mm

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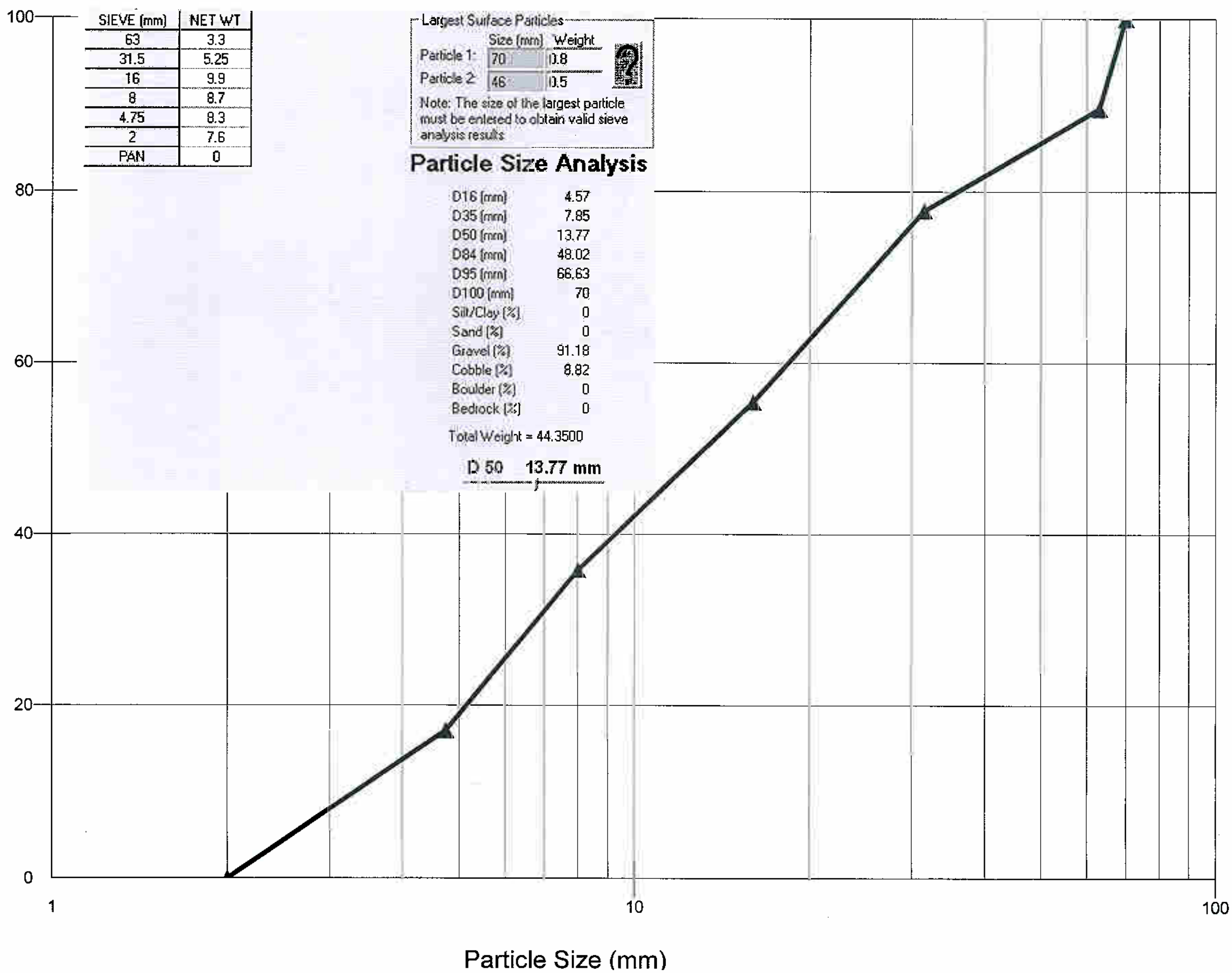
Bar



SIEVE (mm)	NET WT
63	3.3
31.5	5.25
16	9.9
8	8.7
4.75	8.3
2	7.6
PAN	0

Largest Surface Particles

	Size (mm)	Weight
Particle 1:	70	0.8
Particle 2:	46	0.5

Note: The size of the largest particle must be entered to obtain valid sieve analysis results

Particle Size Analysis

D16 (mm)	4.57
D35 (mm)	7.85
D50 (mm)	13.77
D84 (mm)	48.02
D95 (mm)	66.63
D100 (mm)	70
Silt/Clay (%)	0
Sand (%)	0
Gravel (%)	91.18
Cobble (%)	8.82
Boulder (%)	0
Bedrock (%)	0

Total Weight = 44.3500

D 50   13.77 mm

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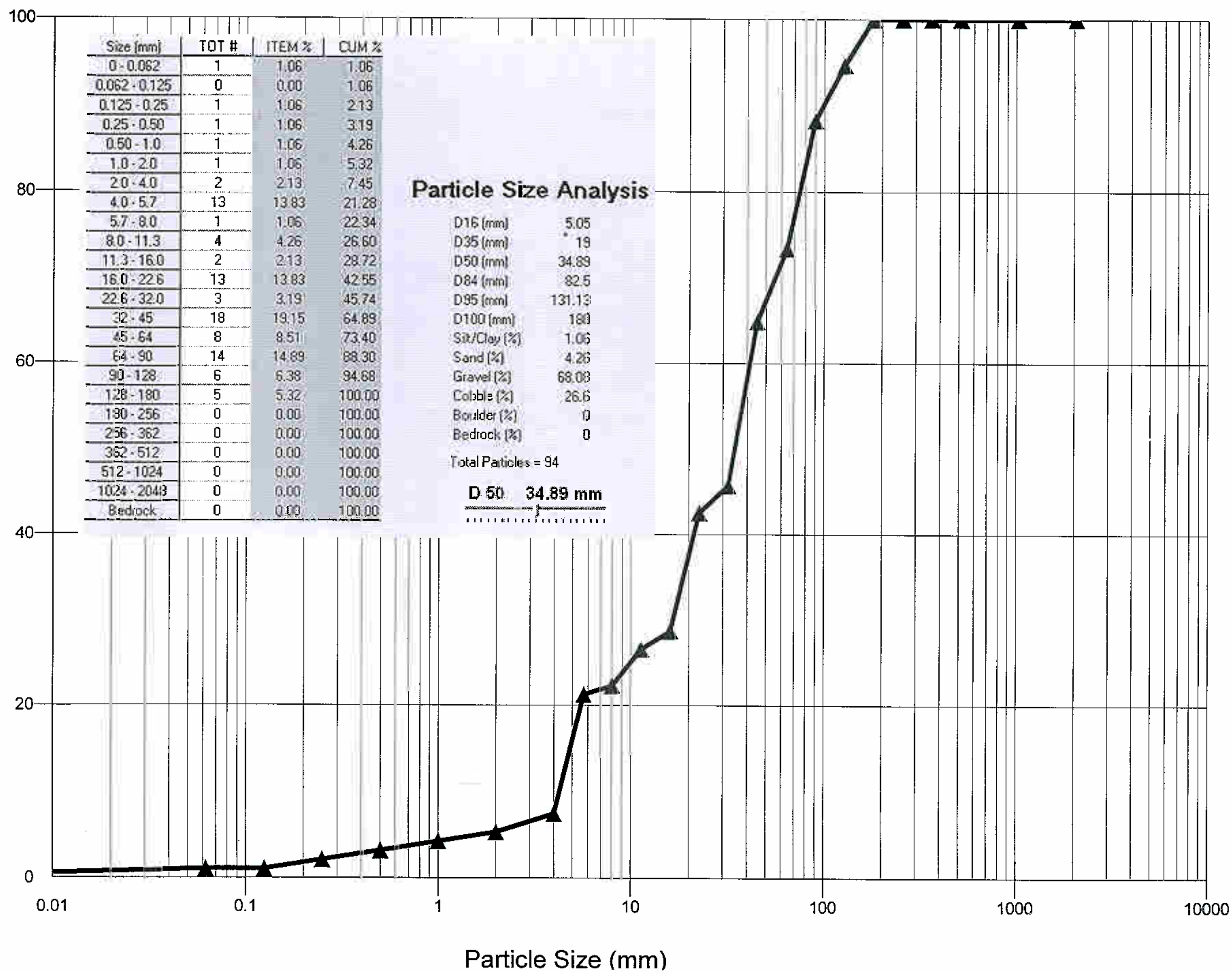
Pool



Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.06	1.06
0.062 - 0.125	0	0.00	1.06
0.125 - 0.25	1	1.06	2.13
0.25 - 0.50	1	1.06	3.19
0.50 - 1.0	1	1.06	4.26
1.0 - 2.0	1	1.06	5.32
2.0 - 4.0	2	2.13	7.45
4.0 - 5.7	13	13.83	21.28
5.7 - 8.0	1	1.06	22.34
8.0 - 11.3	4	4.26	26.60
11.3 - 16.0	2	2.13	28.72
16.0 - 22.6	13	13.83	42.55
22.6 - 32.0	3	3.19	45.74
32 - 45	18	19.15	64.89
45 - 64	8	8.51	73.40
64 - 90	14	14.89	88.30
90 - 128	6	6.38	94.68
128 - 180	5	5.32	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	5.05
D35 (mm)	19
D50 (mm)	34.89
D84 (mm)	82.5
D95 (mm)	131.13
D100 (mm)	180
Silt/Clay (%)	1.06
Sand (%)	4.26
Gravel (%)	68.08
Cobble (%)	26.6
Boulder (%)	0
Bedrock (%)	0

Total Particles = 94

D 50 34.89 mm

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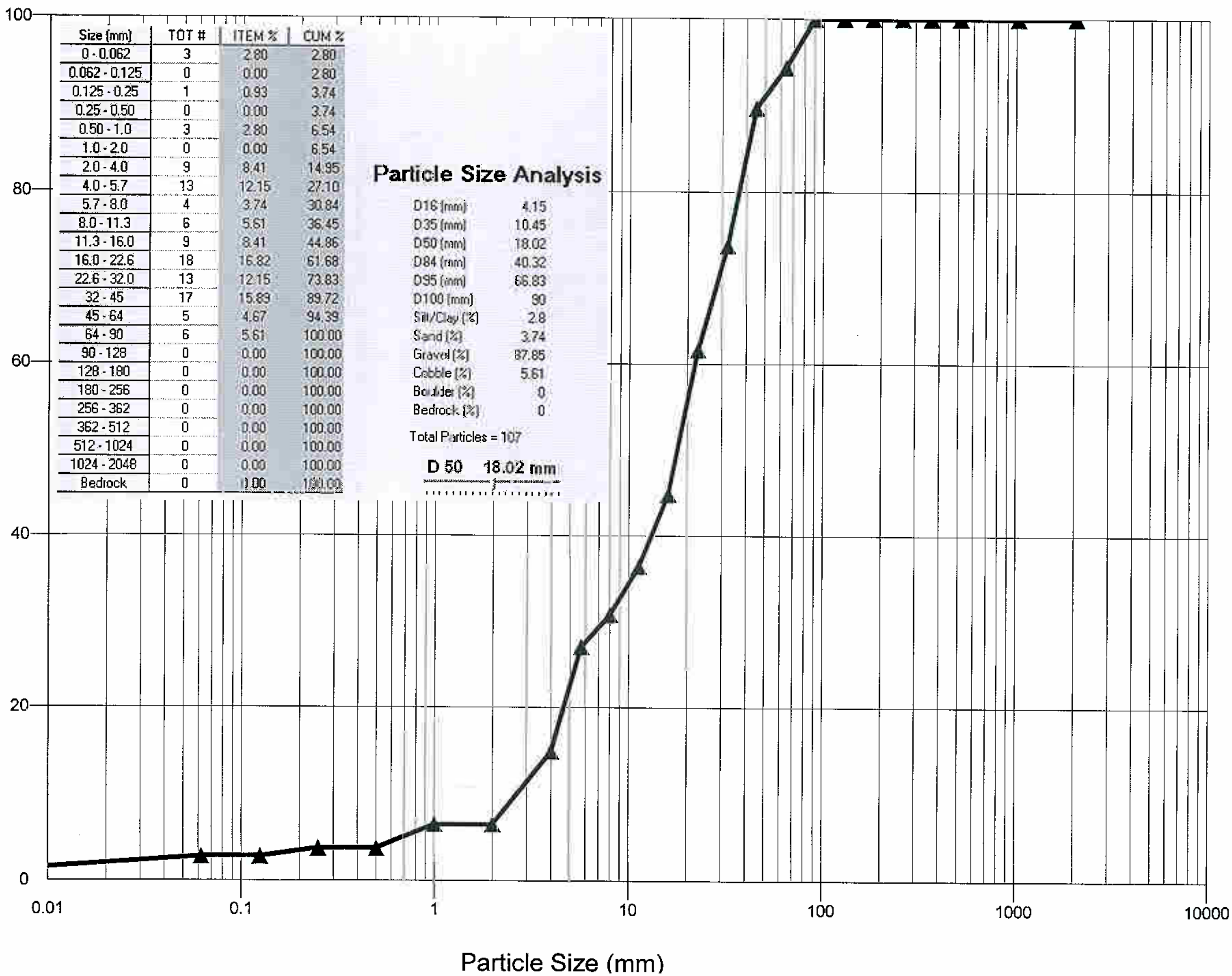
Glide



Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	2.80	2.80
0.062 - 0.125	0	0.00	2.80
0.125 - 0.25	1	0.93	3.74
0.25 - 0.50	0	0.00	3.74
0.50 - 1.0	3	2.80	6.54
1.0 - 2.0	0	0.00	6.54
2.0 - 4.0	9	8.41	14.95
4.0 - 5.7	13	12.15	27.10
5.7 - 8.0	4	3.74	30.84
8.0 - 11.3	6	5.61	36.45
11.3 - 16.0	9	8.41	44.86
16.0 - 22.6	18	16.82	61.68
22.6 - 32.0	13	12.15	73.83
32 - 45	17	15.89	89.72
45 - 64	5	4.67	94.39
64 - 90	6	5.61	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

Particle Size Analysis

D16 (mm)	4.15
D35 (mm)	10.45
D50 (mm)	18.02
D84 (mm)	40.32
D95 (mm)	66.83
D100 (mm)	90
Silt/Clay (%)	2.8
Sand (%)	3.74
Gravel (%)	87.85
Cobble (%)	5.61
Boulder (%)	0
Bedrock (%)	0

Total Particles = 107

D 50 18.02 mm

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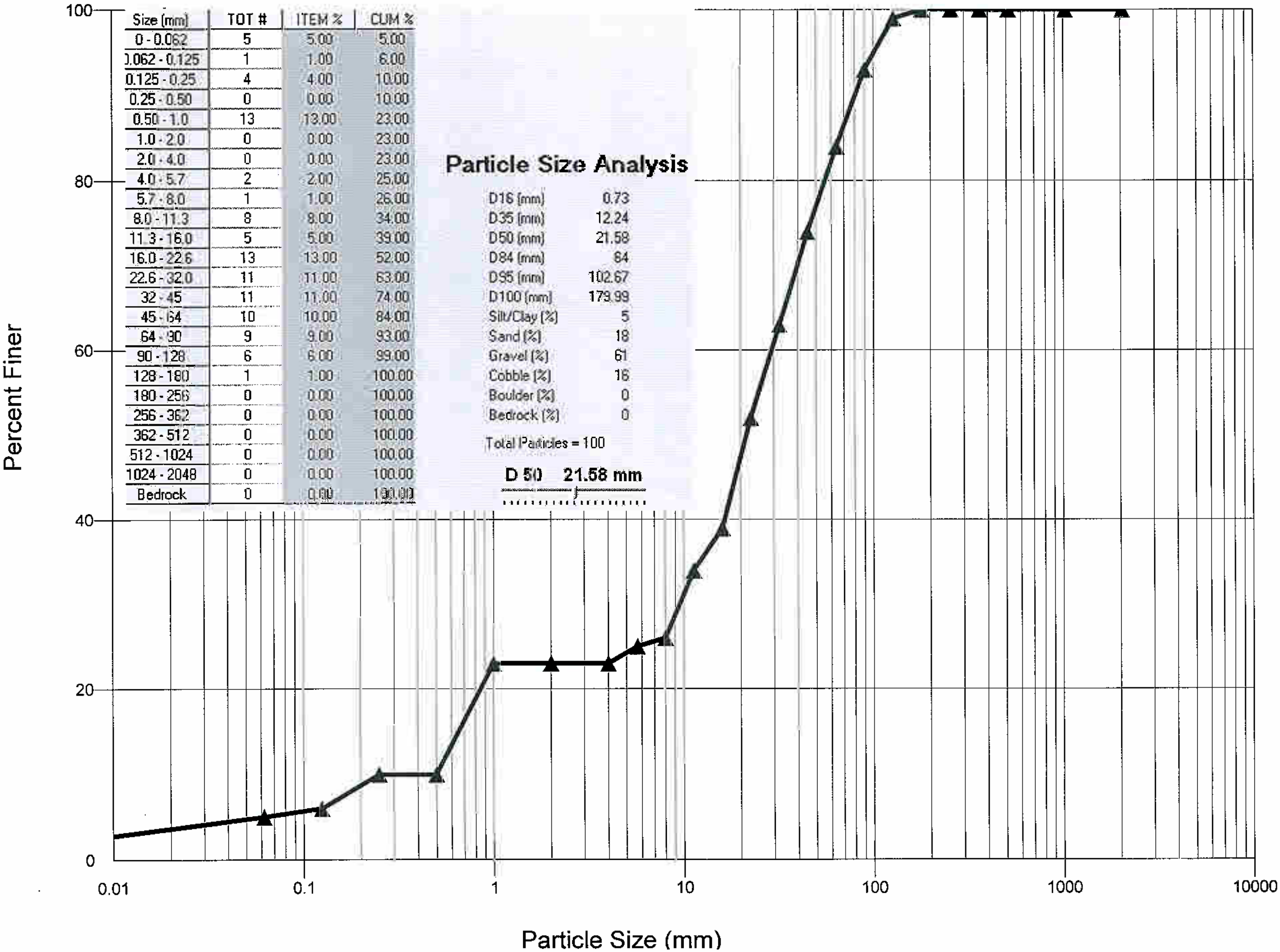
Reach



Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	5	5.00	5.00
.062 - 0.125	1	1.00	6.00
0.125 - 0.25	4	4.00	10.00
0.25 - 0.50	0	0.00	10.00
0.50 - 1.0	13	13.00	23.00
1.0 - 2.0	0	0.00	23.00
2.0 - 4.0	0	0.00	23.00
4.0 - 5.7	2	2.00	25.00
5.7 - 8.0	1	1.00	26.00
8.0 - 11.3	8	8.00	34.00
11.3 - 16.0	5	5.00	39.00
16.0 - 22.6	13	13.00	52.00
22.6 - 32.0	11	11.00	63.00
32 - 45	11	11.00	74.00
45 - 64	10	10.00	84.00
64 - 90	9	9.00	93.00
90 - 128	6	6.00	99.00
128 - 180	1	1.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

Particle Size Analysis

D16 (mm)	0.73
D35 (mm)	12.24
D50 (mm)	21.58
D84 (mm)	64
D95 (mm)	102.67
D100 (mm)	179.99
Silt/Clay (%)	5
Sand (%)	18
Gravel (%)	61
Cobble (%)	16
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100

D 50 21.58 mm

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Macgruder Day 3, Reach - Reach 1**			
Basin:	Drainage Area: **704** acres	**1.1** mi^2	
Location:			
Twp.&Rge: **;**	Sec.&Qtr.: **;**		
Cross-Section Monuments (Lat./Long.): **0 Lat / 0 Long**		Date: **9/26/2007**	
Observers:		Valley Type: VIII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	23.62	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	1.18	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	27.77	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	20.02	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	1.87	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	170.82	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	7.23	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	21.58	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00645	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.5	

Stream Type **C 4** (See **Figure 2-14**)

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2005).

Stream:	Macgruder Day 3, Reach - Reach 1			Location:				
Observers:			Date: 9/26/2007		Valley Type: VIII		Stream Type: C 4	

River Reach Summary Data

Channel Dimension

Mean Riffle Depth (d_{bkf})	1.19	ft	Riffle Width (W_{bkf})	23.61	ft	Riffle Area (A_{bkf})	28.01	ft^2
Mean Pool Depth (d_{bkfp})	1.61	ft	Pool Width (W_{bkfp})	15.14	ft	Pool Area (A_{bkfp})	24.44	ft^2
Mean Pool Depth/Mean Riffle Depth	1.35	d_{bkfp}/d_{bkf}	Pool Width/Riffle Width	0.64	W_{bkfp}/W_{bkf}	Pool Area / Riffle Area	0.87	A_{bkfp}/A_{bkf}
Max Riffle Depth (d_{mbkf})	1.4	ft	Max Pool Depth (d_{mbkfp})	3.88	ft	Max Riffle Depth/Mean Riffle Depth	1.18	
Max Pool Depth/Mean Riffle Depth	3.261					Point Bar Slope	21	
Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})				3.25	ft/s	Estimation Method	Mannings	
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})				91.03	cfs	Drainage Area	1.1	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Meander Length (Lm)	106	85	127	ft	Meander Length Ratio (Lm/W_{bkf})	4.49	3.60	5.38
Radius of Curvature (Rc)	25	21	39	ft	Radius of Curvature/Riffle Width (Rc/W_{bkf})	1.06	0.89	1.65
Belt Width (W_{blt})	35	30	41	ft	Meander Width Ratio (W_{blt}/W_{bkf})	1.48	1.27	1.74
Individual Pool Length	39.5	34.1	45	ft	Pool Length/Riffle Width	1.67	1.44	1.90
Pool to Pool Spacing	58.8	46.5	78.9	ft	Pool to Pool Spacing/Riffle Width	2.49	1.97	3.34
Riffle Length	8.67	5.11	12.2	ft	Riffle Length/Riffle Width	0.37	0.22	0.52

Channel Profile

Valley Slope (VS)	0.009	ft/ft	Average Water Surface Slope (S)	0.00645	ft/ft	Sinuosity (VS/S)	1.34
Stream Length (SL)	243	ft	Valley Length (VL)	166	ft	Sinuosity (SL/VL)	1.464

Low Bank Height (LBH)	start	1.61 ft	Max Riffle Depth	start	1.19 ft	Bank-Height Ratio (BHR) (LBH/Max Riffle Depth)	start	1.353
	end	1.68 ft		end	1.47 ft		end	1.143

Facet Slopes	Mean	Min	Max		Dimensionless Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.036	0.019	0.049	ft/ft	Riffle Slope/Average Water Surface Slope (S_{rif} / S)	5.561	3.008	7.541
Run Slope (S_{run})	0.064	0.051	0.075	ft/ft	Run Slope/Average Water Surface Slope (S_{run} / S)	9.971	7.977	11.612
Pool Slope (S_p)	0.001	0.000	0.002	ft/ft	Pool Slope/Average Water Surface Slope (S_p / S)	0.122	0.000	0.245
Glide Slope (S_g)	0.001	0.000	0.001	ft/ft	Glide Slope/Average Water Surface Slope (S_g / S)	0.078	0.000	0.153

Feature Midpoint [a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Riffle Depth (d_{rif})	1.4	1.18	1.55	ft	Riffle Depth/Mean Riffle Depth (d_{rif} / d_{bkf})	1.18	0.99	1.303
Run Depth (d_{run})	1.62	1.52	1.71	ft	Run Depth/Mean Riffle Depth (d_{run} / d_{bkf})	1.36	1.28	1.437
Pool Depth (d_p)	3.88	3.67	4.08	ft	Pool Depth/Mean Riffle Depth (d_p / d_{bkf})	3.26	3.08	3.429
Glide Depth (d_g)	1.69	1.52	1.79	ft	Glide Depth/Mean Riffle Depth (d_g / d_{bkf})	1.42	1.28	1.504

Channel Materials

	Reach [b]	Riffle [c]	Bar		Reach [b]	Riffle [c]	Bar	Protrusion Height [d]	
% Silt/Clay	5	2.8	0	D_{16}	0.73	4.15	4.57	0	mm
% Sand	18	3.74	0	D_{35}	12.24	10.45	7.85	0	mm
% Gravel	61	87.85	91.18	D_{50}	21.58	18.02	13.77	0	mm
% Cobble	16	5.61	8.82	D_{84}	64	40.32	48.02	0	mm
% Boulder	0	0	0	D_{95}	102.67	66.83	66.63	0	mm
% Bedrock	0	0	0	D_{100}	179.99	90	70	0	mm

a Min, max, mean depths are the average mid-point values except pools, which are taken at deepest part of pool.
b Composite sample of riffles and pools within the designated reach.
c Active bed of a riffle.
d Height of roughness feature above bed.

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River Assessment and Monitoring: Impaired Reach — 3rd Field Day

Worksheet C-3. Bankfull velocity and discharge estimates.

Bankfull VELOCITY / DISCHARGE Estimates

Site		Location	
Date		Stream Type	C4
Valley Type	VIII		
Observers		HUC	

	INPUT VARIABLES			OUTPUT VARIABLES			
35.8	Bankfull Cross-section AREA	22	A_{bkf} (SqFt)	Bankfull Mean DEPTH	1.0	D_{bkf} (Ft)	1.5
23.6	Bankfull WIDTH	23.3	W_{bkf} (Ft)	Wetted PERIMETER $\sim 2 * d_{bkf} + W_{bkf}$ (1.43, 23.3)	49.46	W_{Pbkf} (Ft)	70.8
	D84 @ Riffle (Active channel)	77.05	Dia. (mm)	D84 mm / 304.8 =	.2527	D84 (Ft)	
	Bankfull SLOPE	.006	S (Ft / Ft)	Hydraulic RADIUS A_{bkf} / W_{Pbkf}	0.9	R (Ft)	.5
	Gravitational Acceleration	32.2	g (Ft /Sec^2)	Relative Roughness R (ft) / D84 (ft)	3.5		1.98
	Drainage AREA	1.0	DA (SqMi)	Shear Velocity $u^* = \sqrt{gRS}$	0.42	u* (Ft / Sec)	.312

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 \log\{R / D84 (ft)\}] u^*$	1.41 / 2.48	Ft / Sec	[illegible] / 54.56	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor / relative roughness. $u = 1.4895 * R^{2/3} * S^{1/2} / n$ n = .045 .062	1.62 / 2.37	Ft / Sec	35.4 / 52.15	CFS
2. Roughness Coefficient: $u = 1.4895 * R^{2/3} * S^{1/2} / n$ b) Manning's 'n' from Jarrett (USGS): $n = 0.39 S^{.38} R^{-.16}$ n = .048 Note: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder-dominated stream systems; i.e., for stream types A1, A2, A3, B1, B2, B3, C2 and E3.		Ft / Sec		CFS
2. Roughness Coefficient: c) Manning's 'n' from Stream Type $u = 1.4895 * R^{2/3} * S^{1/2} / n$ n = .048	2.22	Ft / Sec	48.89	CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.)		Ft / Sec		CFS
3. Other Methods, ie. Hydraulic Geometry (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy	2.13	Ft / Sec	46.9	CFS
4. Continuity Equations: a) Regional Curves u = Q / A Return Period for Bankfull Discharge Q = @[illegible] 22	2.54 / 4.13	Ft / Sec	93.41 / 90.86	CFS
4. Continuity Equations: b) USGS Gage Data u = Q / A		Ft / Sec		CFS

$u/u^* \; \frac{2.48}{.42} = 5.$

Curves
Q = 90.95
A = 18.65

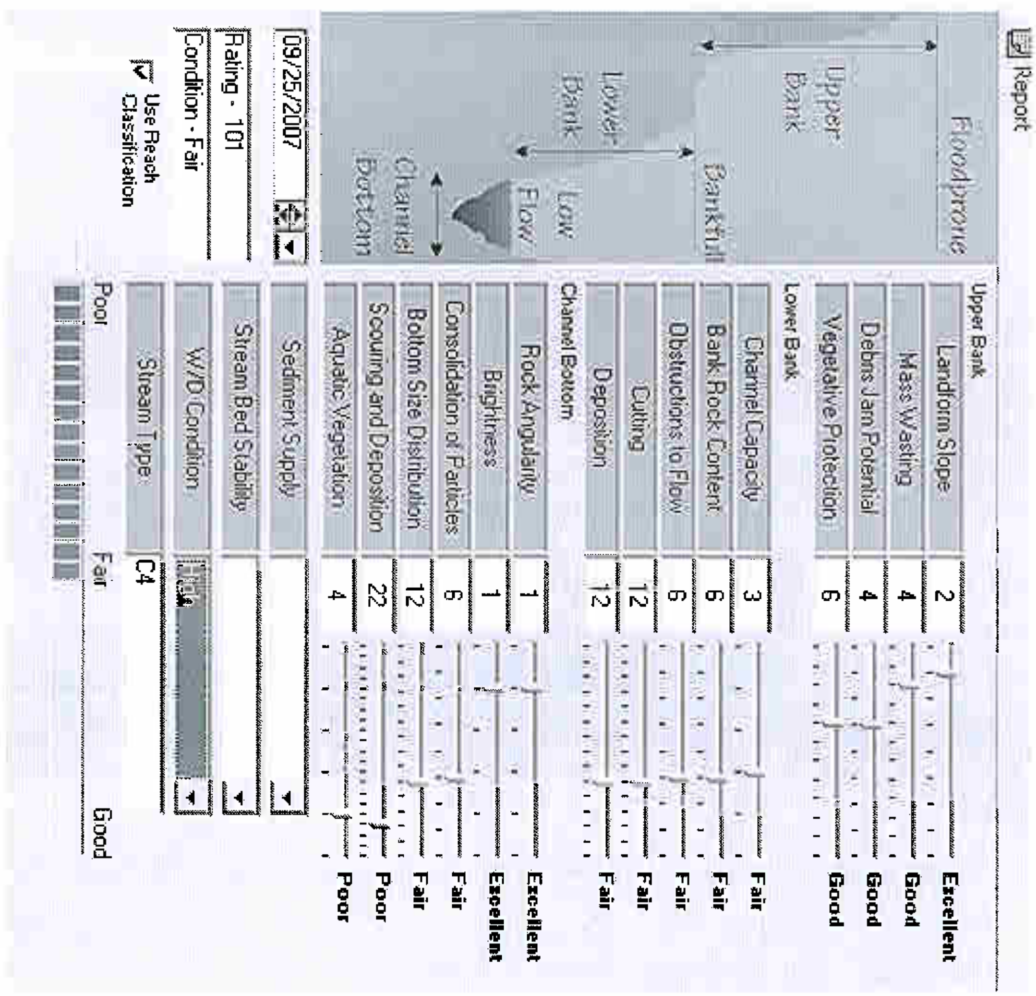
Options for using the D84 term in the **relative roughness relation** (R/D84), when using estimation method 1.

Option 1. For **sand-bed** channels: measure the "**protrusion height**" (h_{sd}) of sand dunes above channel bed elevations. Substitute an average sand dune protrusion height (h_{sd} in feet) for the D84 term in estimation method 1.

Option 2. For **boulder-dominated** channels: measure several "**protrusion heights**" (h_{bo}) of boulders above channel bed elevations. Substitute an average boulder protrusion height (h_{bo} in feet) for the D84 term in estimation method 1.

Option 3. For **bedrock-dominated** channels: measure several "**protrusion heights**" (h_{br}) of rock separations/steps/joints/ uplifted surfaces above channel bed elevations. Substitute an average bedrock protrusion height (h_{br} in feet) for the D84 term in estimation method 1.

6.28


Report
Floodprone
Upper Bank
Lower Bank
Bankfull
Low Flow
Channel bottom
09/25/2007
Rating - 101
Condition - Fair
Use Reach Classification
Upper Bank
Landform Slope 2 Excellent
Mass Wasting 4 Good
Debris Jam Potential 4 Good
Vegetative Protection 6 Good
Lower Bank
Channel Capacity 3 Fair
Bank Rock Content 6 Fair
Obstructions to Flow 6 Fair
Cutting 12 Fair
Deposition 12 Fair
Channel Bottom
Rock Angularity 1 Excellent
Brightness 1 Excellent
Consolidation of Particles 6 Fair
Bottom Size Distribution 12 Fair
Scouring and Deposition 22 Poor
Aquatic Vegetation 4 Poor
Sediment Supply
Stream Bed Stability
W/D Condition
Stream Type C4
Poor
Fair
Good

Worksheet 5-12a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream: **Magruder Branch Reference Reach, Reach 3, ref r** Location: **Reach 3** Date: **09/18/07**

Observers: **Team 3** Stream Type: **C4** Valley Type: **VIII** Gage Station #: **01591000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.07										0%						
90.0%	2.80	1.43	1.51	8.71	0.17	0.93	0.006	0.06	0.54	0.06	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	4.06	3.43	2.88	11.73	0.25	1.17	0.006	0.09	1.28	0.11	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	4.97	4.51	3.51	12.77	0.27	1.27	0.006	0.10	1.69	0.13	10%	36.50	0.00	0.00	0.00	0.00	0.00
60.0%	6.23	5.60	4.07	13.41	0.30	1.36	0.006	0.11	2.10	0.16	10%	36.50	0.00	0.00	0.00	0.00	0.00
50.0%	8.12	7.18	4.86	14.28	0.34	1.47	0.006	0.13	2.69	0.19	10%	36.50	0.00	0.00	0.00	0.00	0.00
40.0%	9.95	9.04	5.72	15.16	0.38	1.57	0.006	0.14	3.38	0.22	10%	36.50	0.00	0.00	0.00	0.00	0.00
30.0%	12.47	11.21	6.58	15.66	0.42	1.69	0.006	0.16	4.20	0.27	10%	36.50	0.00	0.10	0.00	0.01	0.01
20.0%	16.18	14.33	7.70	15.84	0.49	1.86	0.006	0.18	5.37	0.34	10%	36.50	0.00	0.10	0.00	0.01	0.01
10.0%	22.41	19.30	9.27	16.09	0.58	2.08	0.006	0.21	7.23	0.45	10%	36.50	0.40	0.20	0.04	0.02	0.06
5.0%	31.45	26.93	11.44	16.45	0.70	2.35	0.006	0.26	10.08	0.61	5%	18.25	0.90	0.30	0.05	0.02	0.07
4.0%	35.16	33.31	13.10	16.72	0.78	2.54	0.006	0.29	12.47	0.75	1%	3.65	1.30	0.6	0.01	0.01	0.02
3.0%	40.76	37.96	14.25	16.90	0.84	2.66	0.006	0.31	14.21	0.84	1%	3.65	1.70	0.80	0.02	0.01	0.03
2.0%	52.60	46.68	16.27	17.19	0.95	2.87	0.01	0.34	17.48	1.02	1%	3.65	3.00	1.50	0.03	0.02	0.05
1.5%	63.17	57.89	18.82	16.99	1.11	3.07	0.005	0.38	21.67	1.28	1%	1.83	4.80	2.90	0.02	0.01	0.03
1.0%	79.70	71.44	21.89	15.95	1.37	3.26	0.00	0.42	26.75	1.68	1%	1.83	7.80	5.60	0.04	0.03	0.07
Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):															76.7	51.1	127.8

Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: Day 3 - Impaired Reach, Reach 1, Riffle 1+36, (Riffk Location: Reach 3 Date: 09/18/07

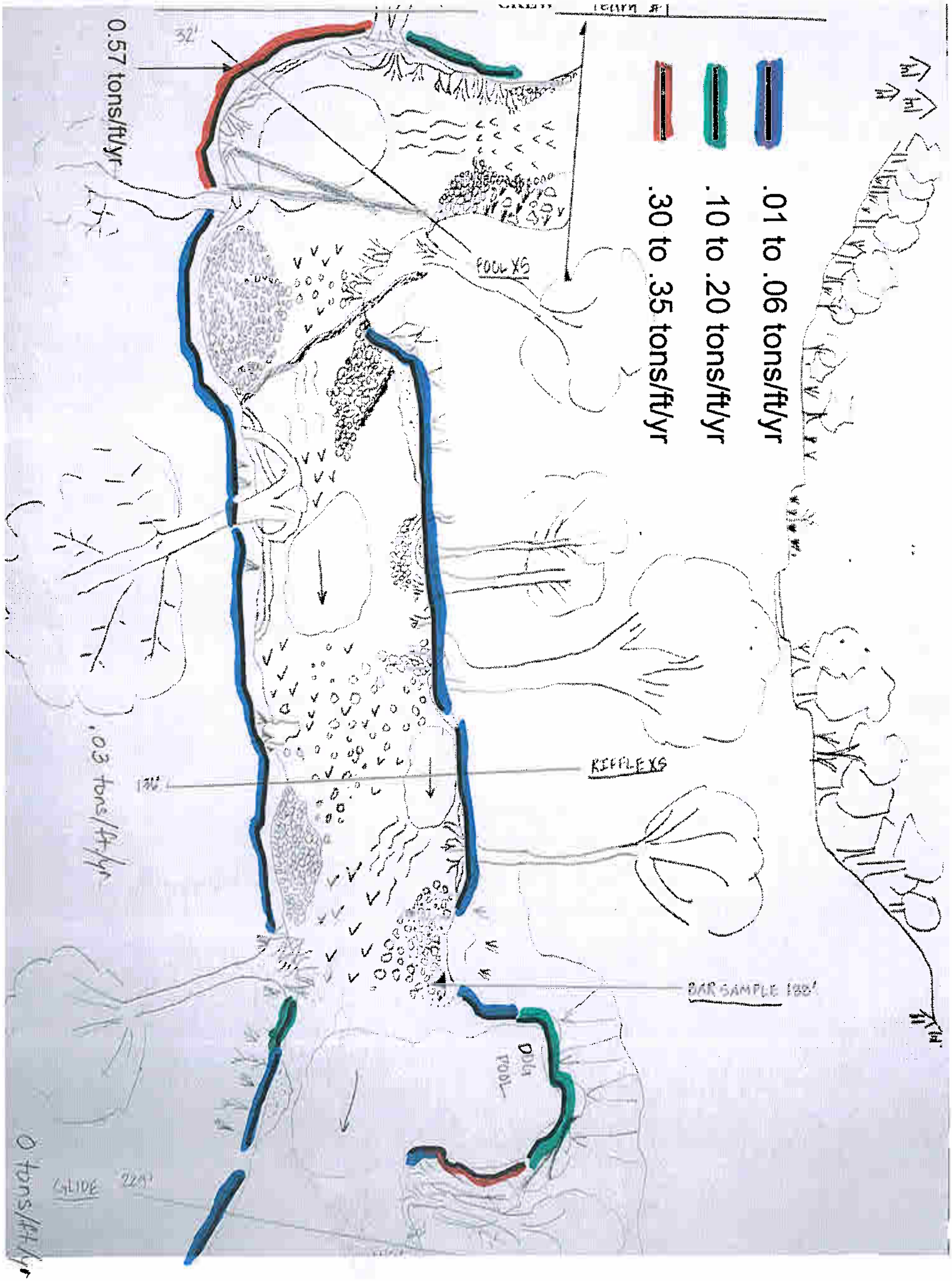
Observers: Team 3 Stream Type: C4 Valley Type: VIII Gage Station #: 01591000

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.0%	0.07										0%						
90.0%	2.78	1.42	1.37	8.35	0.16	0.99	0.006	0.06	0.53	0.06	10%	36.50	0.00	0.00	0.00	0.00	0.00
80.0%	4.03	3.41	2.67	11.21	0.24	1.27	0.006	0.09	1.28	0.11	10%	36.50	0.00	0.00	0.00	0.00	0.00
70.0%	4.94	4.49	3.17	11.56	0.27	1.39	0.006	0.10	1.68	0.15	10%	36.50	0.00	0.00	0.00	0.00	0.00
60.0%	6.19	5.57	3.67	11.90	0.31	1.51	0.006	0.11	2.09	0.18	10%	36.50	0.00	0.00	0.00	0.00	0.00
50.0%	8.07	7.13	4.30	12.25	0.35	1.64	0.006	0.13	2.67	0.22	10%	36.50	0.00	0.00	0.00	0.00	0.00
40.0%	9.88	8.98	5.03	12.63	0.40	1.79	0.006	0.14	3.36	0.27	10%	36.50	0.00	0.10	0.00	0.01	0.01
30.0%	12.38	11.13	5.78	13.02	0.44	1.91	0.006	0.16	4.17	0.32	10%	36.50	0.00	0.10	0.00	0.01	0.01
20.0%	16.07	14.23	6.81	13.55	0.50	2.08	0.006	0.18	5.33	0.39	10%	36.50	0.00	0.10	0.00	0.01	0.01
10.0%	22.26	19.17	8.32	14.24	0.58	2.30	0.006	0.21	7.18	0.50	10%	36.50	0.40	0.20	0.04	0.02	0.06
5.0%	31.23	26.75	10.38	14.94	0.69	2.57	0.006	0.25	10.02	0.67	5%	18.25	0.90	0.40	0.05	0.02	0.07
4.0%	34.92	33.08	11.94	15.40	0.78	2.77	0.006	0.28	12.39	0.80	1%	3.65	1.70	0.6	0.02	0.01	0.03
3.0%	40.48	37.70	13.03	15.72	0.83	2.89	0.006	0.30	14.11	0.90	1%	3.65	2.20	0.90	0.02	0.01	0.03
2.0%	52.23	46.36	14.99	16.32	0.92	3.09	0.01	0.33	17.36	1.06	1%	3.65	3.50	1.60	0.04	0.02	0.06
1.5%	62.74	57.49	19.31	22.46	0.86	2.98	0.006	0.31	21.52	0.96	1%	1.83	2.60	1.60	0.01	0.01	0.02
1.0%	79.15	70.95	22.29	23.41	0.95	3.18	0.01	0.34	26.56	1.13	1%	1.83	3.90	2.80	0.02	0.01	0.03

Notes:

	(16)	(17)	(18)
Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	73.0	47.5	120.5
Upstream total annual sediment supply (tons/yr) (Worksheet 5-12a):	76.0	51.0	127.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-3.0	-3.6	-6.6
Stability evaluation: Aggradation, Degradation or Stable:			

Magruder Branch Degraded Reach   Team 1   9/25/2007



RB

Worksheet 5-10. Summary form of annual streambank erosion estimates for various study reaches.

Stream:	Macgruder Day 3, Reach - Reach 1		Location:				
Graph Used:		Total Bank Length (ft): 242				Date: 9/26/2007	
Observers:			Valley Type:			Stream Type:	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 5-8) (adjective)**	**NBS rating (Worksheet 5-9) (adjective)**	**Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}**
1. **RB 201-209**	**Moderate**	**Low**	**0.1084821**	**8**	**2.8**	**2.43**	**0.01**
2. **RB 225-240**	**Low**	**Moderate**	**0.09**	**15**	**1.6**	**2.16**	**0.01**
3. **Station 006 - 025 R**	**Low**	**Extreme**	**1.9986418**	**19**	**3.1**	**117.72**	**0.30**
4. **Station 025 - 029 R**	**Moderate**	**Extreme**	**2.0039063**	**4**	**3.2**	**25.65**	**0.31**
5. **Station 029 - 039 R**	**High**	**Low**	**1.9996875**	**10**	**3.2**	**63.99**	**0.31**
6. **Station 045-048 rb**	**High**	**Low**	**0.1928571**	**3**	**2.8**	**1.62**	**0.03**
7. **Station 048-063 rb**	**High**	**Very Low**	**0.2290909**	**15**	**2.2**	**7.56**	**0.02**
8. **Station 063-072rb**	**High**	**Low**	**0.4**	**9**	**3.3**	**11.88**	**0.06**
9. **Station 099-111rb**	**Moderate**	**Low**	**0.0964286**	**12**	**2.1**	**2.43**	**0.01**
10. **Station 111-122 rb**	**Moderate**	**Low**	**0.0954545**	**11**	**1.8**	**1.89**	**0.01**
11.							
12.							
13.							
14.							
15.							

RB + LB TOTAL:

Sum erosion subtotals in Column (7) for each BEHI/NBS combination	Total erosion (ft^3/yr)	237.33	370.71
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}	Total erosion (yds^3/yr)	8.79	13.73
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}	Total erosion (tons/yr)	11.43	17.85
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}	Total erosion (tons/yr/ft)	0.0472	.0737

LB

Worksheet 5-10. Summary form of annual streambank erosion estimates for various study reaches.

Stream:	Macgruder Day 3, Reach - LEFT BANK BI		Location:				
Graph Used:		Total Bank Length (ft): 242				Date: 12/30/1999	
Observers:			Valley Type:			Stream Type:	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Station (ft)	**BEHI rating (Worksheet 5-8) (adjective)**	**NBS rating (Worksheet 5-9) (adjective)**	**Bank erosion rate (Figure 5-38 or 5-39) (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}**
1. GLIDE X-SECT. 229	Low	Low	0	1	1.6	0	0.00
2. LB 220	Low	Moderate	0.10125	8	3	2.43	0.01
3. LB 66-41	Moderate	Low	0.108	25	1.6	4.32	0.01
4. LB 80-66	High	Very Low	0.2268908	14	1.7	5.4	0.02
5. LB146-132	High	Very Low	0.2285714	14	2.7	8.64	0.03
6. LB157-146	Moderate	Low	0.1	11	2.7	2.97	0.01
7. LB168-157	High	Low	0.2045455	11	1.2	2.7	0.01
8. LB195-206	Moderate	Low	0.1125	16	2.7	4.86	0.01
9. LB204-214	High	Extreme	1.4989967	23	2.6	89.64	0.19
10. Pool XS032	Extreme	Extreme	3.96	1	3	11.88	0.57
11. RIFFLE X-SEC 136.25	High	Very Low	0.216	1	2.5	0.54	0.03
12.							
13.							
14.							
15.							
Sum erosion subtotals in Column (7) for each BEHI/NBS combination					Total erosion (ft^3/yr)	133.38	
Convert erosion in ft^3/yr to yds^3/yr {divide Total erosion (ft^3/yr) by 27}					Total erosion (yds^3/yr)	4.94	
Convert erosion in yds^3/yr to tons/yr {multiply Total erosion (yds^3/yr) by 1.3}					Total erosion (tons/yr)	6.42	
Calculate erosion per unit length of channel {divide Total erosion (tons/yr) by total length of stream (ft) surveyed}					Total erosion (tons/yr/ft)	0.0265	

a. Riparian Vegetation

Worksheet C-4. Riparian vegetation composition/density used for channel stability assessment.

Riparian Vegetation			
Stream: Magruder		Location: Reach 1	
Observers: Team 1	Reference reach ☐	Disturbed (impacted reach) ☒	Date: 9/~~26~~ 25/07
Existing species composition: Tulip Poplar Dominated Mixed Riparian Hardwood		Potential species composition: OAK-Hickory Dominated Mixed Hardwoods	

	Riparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition
1. Overstory	Canopy layer	95	10	Tulip Poplar	~~20~~ 75
				~~Maple~~ Maple	20
				Sycamore	~~5~~ 2.5
				Ash	2.5
					100%
2. Understory	Shrub layer		25	Multiflora Rose	10
				Spice Bush	60
				~~Maple~~	
				Barberry	5
				Iron Wood	20
				Service berry	5
					100%
3. Ground level	Herbaceous		~~40~~ 35	Japanese Stiltgrass	60
				Clearweed	5
				Plantain	5
				Golden Rod	5
				Honeysuckle	5
				~~Roo~~ fern	20
					100%
	Leaf or needle litter		20	Remarks:	
	Bare ground		10	Condition, vigor and/or usage of existing reach:	
			Column total = 100%		

*Based on crown closure.
**Based on basal area to surface area.

b. Flow Regime

Worksheet C-5. Flow Regime variables that influence channel characteristics, sediment regime and biological interpretations.

FLOW REGIME								
Stream:	Location:							
Observers:	Date:							
List ALL COMBINATIONS that APPLY...............	P2	P8						

General Category

E	Ephemeral stream channels: flows only in response to precipitation. Often used in conjunction with intermittent.
S	Subterranean stream channel: flows parallel to and near the surface for various seasons - a sub-surface flow that follows the stream bed.
I	Intermittent stream channel: one that flows only seasonally or sporadically. Surface sources involve springs, snowmelt, artificial controls, etc. Often this term is associated with flows that reappear along various locations of a reach then run subterranean.
P	Perennial stream channels: surface water persists yearlong.

Specific Category

1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.
4	Streamflow regulated by glacial melt.
5	Ice flows/ice torrents from ice dam breaches.
6	Alternating flow/backwater due to tidal influence.
7	Regulated streamflow due to diversions, dam release, dewatering, etc.
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.
9	Rain-on-snow generated runoff.

c. Stream Size and Order

Worksheet C-6. Stream size/order categories for stratification by stream type.

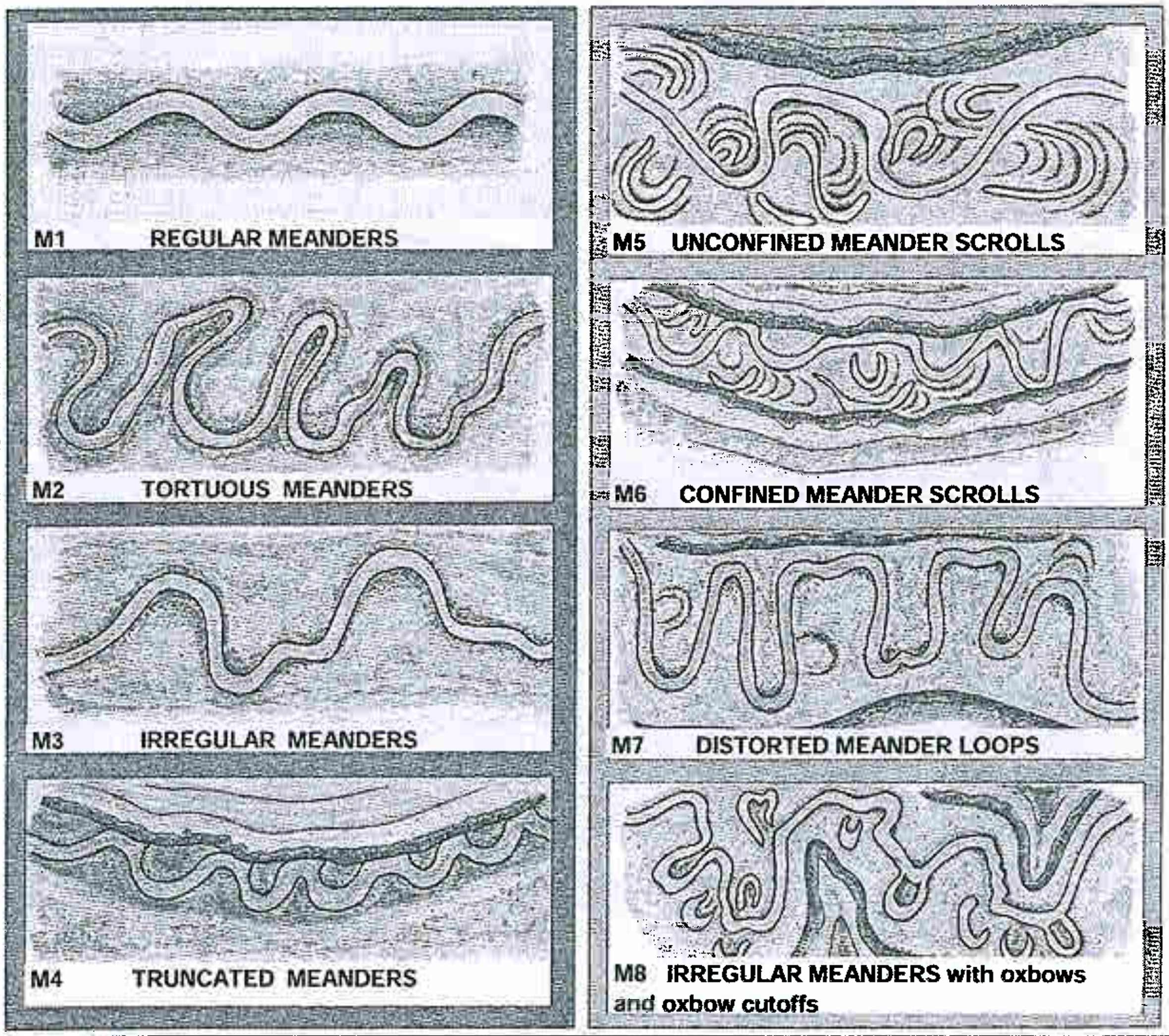
Stream Size and Order			
Stream:			
Location:			
Observers:			
Date:			
Stream Size Category and Order ☞			S4(2)
Category	**STREAM SIZE: Bankfull width**		**Check (✓) appropriate category**
	meters	**feet**	
S-1	0.305	<1	☐
S-2	0.3 – 1.5	1 – 5	☐
S-3	1.5 – 4.6	5 – 15	☐
S-4	4.6 – 9	15 – 30	☑
S-5	9 – 15	30 – 50	☐
S-6	15 – 22.8	50 – 75	☐
S-7	22.8 – 30.5	75 – 100	☐
S-8	30.5 – 46	100 – 150	☐
S-9	46 – 76	150 – 250	☐
S-10	76 – 107	250 – 350	☐
S-11	107 – 150	350 – 500	☐
S-12	150 – 305	500 – 1000	☐
S-13	>305	>1000	☐
Stream Order			
Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).			

d. Meander Patterns

Worksheet C-7. Meander pattern relations used for interpretations for river stability.

Meander Patterns					
Stream:		Reach:			
Observers:		Date:			
List ALL CATEGORIES that APPLY ☞	m2	m3			

Various Meander Pattern variables modified from Galay et al. (1973)

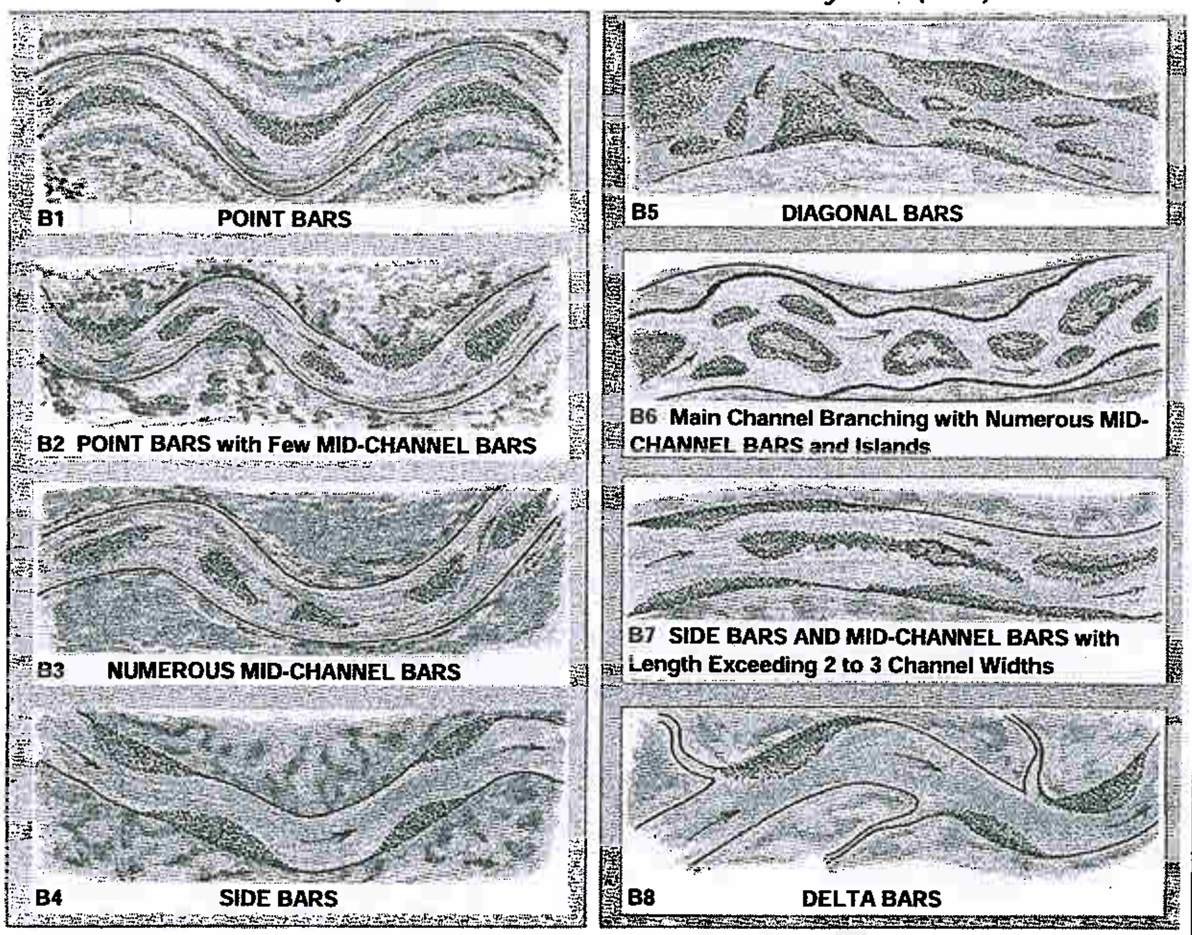


e. Depositional Patterns

Worksheet C-8. Depositional patterns used for stability assessment interpretations.

Depositional Patterns					
Stream:		Reach:			
Observers:		Date:			
List ALL CATEGORIES that APPLY ☞	B1	B5			

Various Depositional Features modified from Galay et al. (1973)



f. Channel Blockages

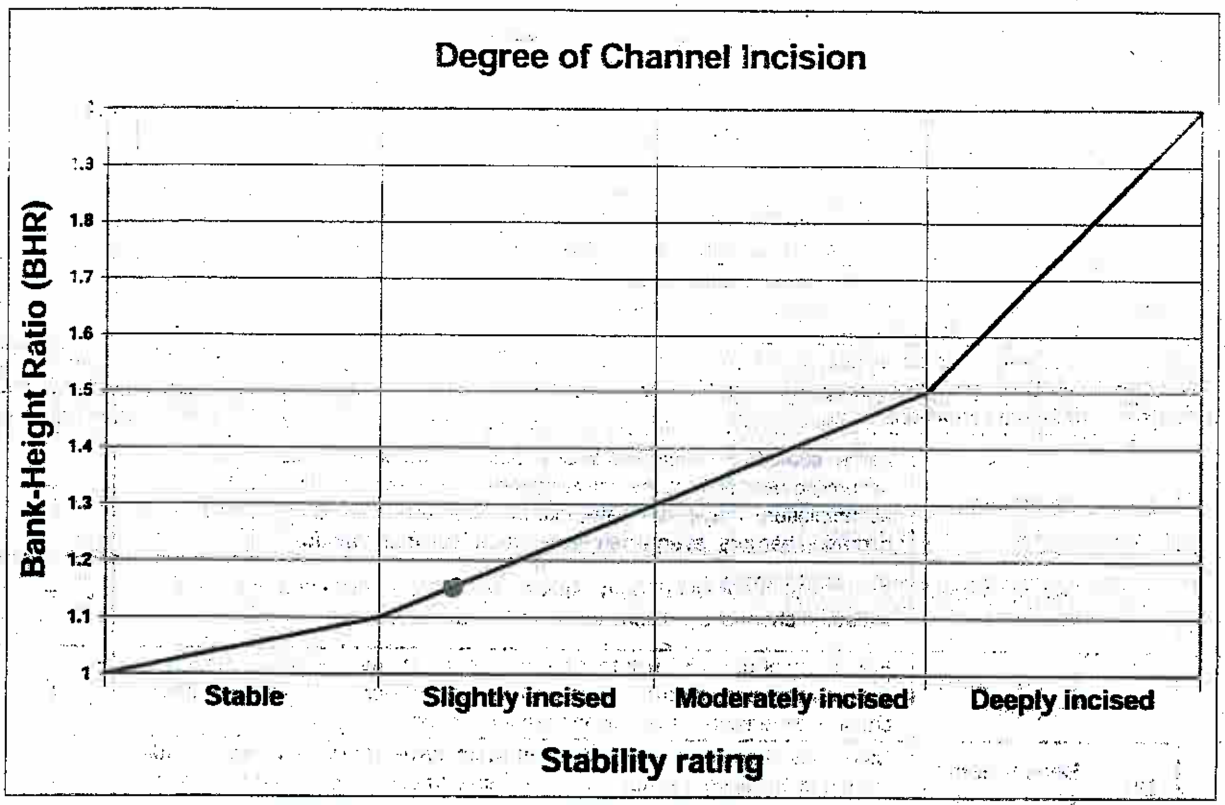
Worksheet C-9. Various categories of in-channel debris, dams and/or channel blockages used to evaluate channel stability.

Channel Blockages			
Stream:		Location:	
Observers:		Date:	
Description/extent		**Materials, which upon placement into the active channel or flood-prone area, may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.**	**Check (✓) all that apply**
D1	None	Minor amounts of small, floatable material.	☐
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	☐
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	✓
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.	☐
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.	☐
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.	☐
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.	☐
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.	☐
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.	☐
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	☐

g. Degree of Channel Incision (Bank-Height Ratio)

Worksheet C-10. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings to determine degree of channel incision.

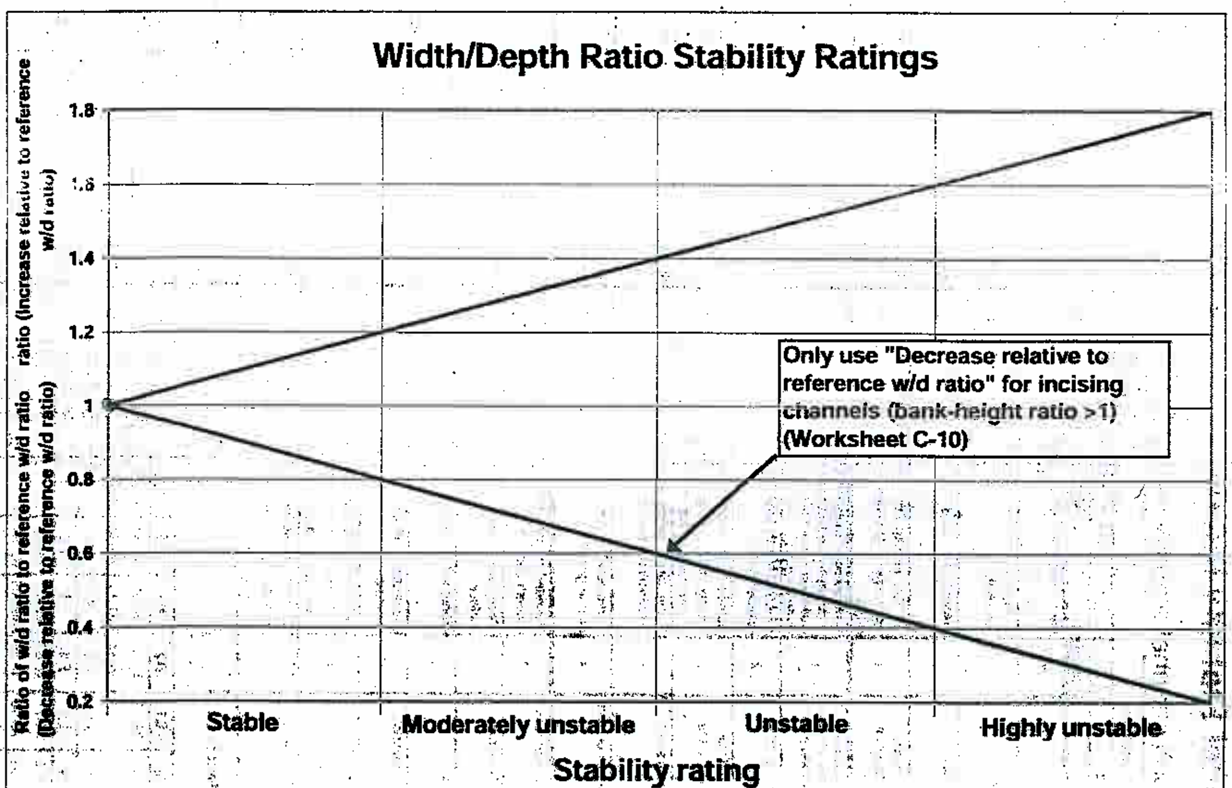
Degree of Channel Incision			
Low Bank Height:	1.61	Bank-Height Ratio:	1.15
Max Bankfull Depth:	1.4		
Degree of Channel Incision Stability Rating		SLIGHTLY INCISED	



i. Width/Depth Ratio State

Worksheet C-12. Width/depth ratio state stability rating.

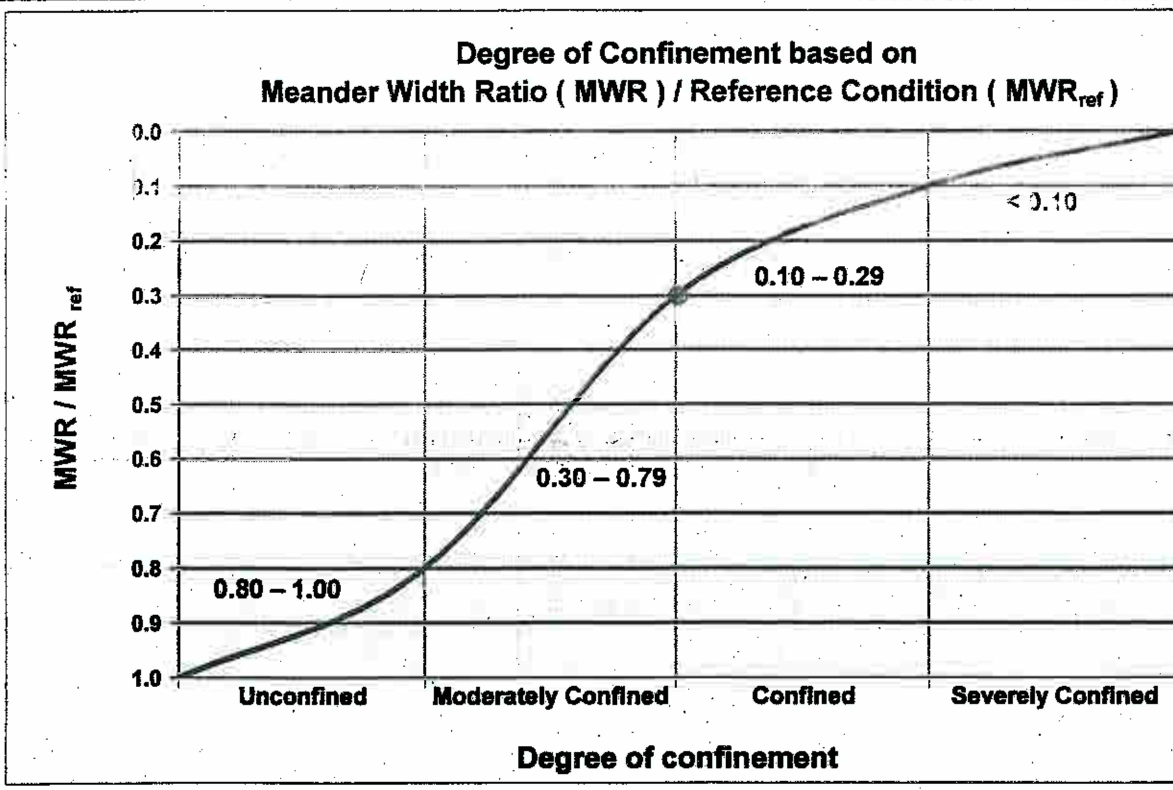
Width/Depth Ratio State			
Existing Width/Depth Ratio:	23	Ratio of existing w/d to reference w/d:	1
Reference Width/Depth Ratio:	21		
Width/Depth Ratio State Stability Rating		STABLE	



j. Degree of Channel Confinement (Meander Width Ratio (MWR))

Worksheet C-13. Degree of confinement stability ratings based on meander width ratio divided by reference meander width ratio.

Degree of Confinement			
Existing Meander Width Ratio (MWR):	1.5	Ratio of MWR to MWRref:	0.13
Reference Meander Width Ratio (MWR_{ref}):	11.4		
Degree of Confinement Stability Rating			CONFINED



Worksheet C-19. Stability ratings for corresponding successional stage shifts of stream types. Check (✓) the appropriate stability rating.

Stream:	Stream Type:
Location:	Valley Type:
Observers:	Date:
Stream type changes due to successional stage shifts (Figure C-5)	**Stability rating (check appropriate rating)**
Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C)	☐ Stable
(E→C) c- wider c	☒ Moderately unstable
(G→F), (F→D), (C→F)	☐ Unstable
(C→D), (B→G), (D→G), (C→G), (E→G)	☐ Highly unstable

Worksheet C-20. Lateral stability prediction summary.

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Lateral stability criteria (choose one stability category for each criterion 1–5)	**Lateral stability categories**				**Selected points (from each row)**
	Stable	**Moderately unstable**	**Unstable**	**Highly unstable**	
20.0 1 **W/d ratio state (Worksheet C-12)**	< 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	> 1.6 (8)	8
2 **Depositional pattern (Worksheet C-8)**	B1, B2 (1)	B4, B8 (2)	B3 (3)	B5, B6, B7 (4)	4
3 **Meander pattern (Worksheet C-7)**	M1, M3, M4 (1)		M2, M5, M6, M7, M8 (3)		3
4 **Dominant BEHI / NBS (Worksheet C-16)**	L/VL, L/L, L/M, L/H, L/VH, M/VL (2)	M/L, M/M, M/H, L/Ex, H/L (4)	M/VH, M/Ex, H/L, H/M, H/H, VH/VL, Ex/VL (6)	H/H, H/Ex, Ex/M, Ex/H, Ex/VH, VH/VH, Ex/Ex (8)	4
5 **Degree of confinement (MWR / MWR_{ratio}) (Worksheet C-13)**	0.8 – 1.0 (1)	0.3 – 0.79 (2)	0.1 – 0.29 (3)	< 0.1 (4)	3
				Total points	~~14~~ 22
	Lateral stability category point range				
Overall lateral stability category (use total points and check stability rating)	**Stable** 7 – 9 ☐	**Moderately unstable** 10 – 12 ☐	**Unstable** 13 – ~~21~~ ~~☑~~	**Highly unstable** > 21 ☑	

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Worksheet C-18. Sediment competence calculation form to assess bed stability.

Stream: Macgruder			Stream Type:	
Location:			Valley Type:	
Observers:			Date: 9/26/07	
Enter required information				
34.29	D_{50}	Riffle bed material D_{50} (mm) Active channel		
9.4	$\hat{D}_{50}$	Bar sample D_{50} (mm)		
.23	D_{max}	Largest particle from bar sample (ft)	70 (mm)	304.8 mm/ft
.006	S	Existing bankfull water surface slope (ft/ft)		
1.2	d	Existing bankfull mean depth (ft)		
1.7	γ_s	Submerged specific weight of sediment		
Select the appropriate equation and calculate critical dimensionless shear stress				
2.2	$D_{50}/\hat{D}_{50}$	Range: 3 – 7	Use EQUATION 1: $\tau^* = 0.0834\,(D_{50}/\hat{D}_{50})^{-0.872}$	
2.04	D_{max}/D_{50}	Range: 1.3 – 3.0 7.35	Use EQUATION 2: $\tau^* = 0.0384\,(D_{max}/D_{50})^{-0.887}$	
.02	τ^*	Bankfull Dimensionless Shear Stress	EQUATION USED:	Dmax
Calculate bankfull mean depth required for entrainment of largest particle in bar sample				
1.30	d	Required bankfull mean depth (ft)	$d = \frac{\tau^* \gamma_s D_{max}\ \text{ft.}}{S}$	
		Check: ☐ Stable ☐ Aggrading ☐ Degrading Stable, trend tod. aggrading		
Calculate bankfull water surface slope required for entrainment of largest particle in bar sample				
.006	S	Required bankfull water surface slope (ft/ft)	$S = \frac{\tau^* \gamma_s D_{max}\ \text{ft.}}{d}$ = 1.3	
		Check: ☑ Stable ☐ Aggrading ☐ Degrading		
Sediment competence using dimensional shear stress				
.45	Bankfull shear stress $\tau = \gamma dS$ (62.4) (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d)			
80	Moveable particle size (mm) at bankfull shear stress **(Figure C-4)**			
.33	Predicted shear stress required to initiate movement of D_{max} (mm) (70) **(Figure C-4)**			
0.88	Predicted mean depth required to initiate movement of D_{max} (mm) $d = \frac{\tau}{\gamma S}$			
.006	Predicted slope required to initiate movement of D_{max} (mm) $S = \frac{\tau}{\gamma d}$			

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Worksheet C-21. Vertical stability prediction for excess deposition/aggradation.

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Vertical stability criteria (choose one stability category for each criterion 1–6)	Vertical stability categories for excess deposition / aggradation				Selected points (from each row)
	No deposition	Moderate deposition	Excess deposition	Aggradation	
1 **Sediment competence (Worksheet C-18)**	Sufficient depth and/or slope to transport largest size available (2)	Trend toward insufficient depth and/or slope-slightly incompetent (4)	Cannot move D_{35} of bed material and/or D_{100} of bar material (6)	Cannot move D_{16} of bed material and/or D_{100} of bar or sub-pavement size (8)	2
2 **Sediment capacity (POWERSED)**	Sufficient capacity to transport annual load (2)	Trend toward insufficient sediment capacity (4)	Reduction up to 25% of annual sediment yield of bedload and/or suspended (6)	Reduction over 25% of annual sediment yield for bedload and/or suspended (8)	4
3 **W/d ratio state (Worksheet C-12)**	1.0 – 1.2 (2)	1.2 – 1.4 (4)	1.4 – 1.6 (6)	>1.6 (8)	~~2~~ 8
4 **Stream succession states (Worksheet C-19)**	Current stream type at potential or does not indicate deposition/ aggradation (2)	(E→C) (4)	(C→High w/d C), (B→High w/d B), (C→F) (6)	(C→D), (F→D) (8)	6
5 **Depositional patterns (Worksheet C-8)**	B1 (1)	B2, B4 (2)	B3, B5 (3)	B6, B7, B8 (4)	3
6 **Debris / blockages (Worksheet C-9)**	D1, D2, D3 (1)	D4, D7 (2)	D5, D8 (3)	D6, D9, D10 (4)	1
				Total points	~~18~~
	Vertical stability category point range for excess deposition / aggradation				
Vertical stability for excess deposition / aggradation (use total points and check stability rating)	**No deposition 10 – 14** ☐	**Moderate deposition 15 – 20** ☒	**Excess deposition 21 – 30** ☑	**Aggradation > 30** ☐	24

Worksheet C-22. Vertical stability prediction for channel incision/degradation.

Stream:	Stream Type:
Location:	Valley Type:
Observers:	Date:

Vertical stability criteria (choose one stability category for each criterion 1–5)	Vertical stability categories for channel incision / degradation				Selected points (from each row)
	Not incised	Slightly incised	Moderately incised	Degradation	
1 **Sediment competence (Worksheet C-18)**	Does not indicate excess competence (2)	Trend to move larger sizes than D_{100} of bar or > D_{84} of bed (4)	D_{100} of bed moved (6)	Particles much larger than D_{100} of bed moved (8)	2
2 **Sediment capacity (POWERSED)**	Does not indicate excess capacity (2)	Slight excess energy: up to 10% increase above reference (4)	Excess energy sufficient to increase load up to 50% of annual load (6)	Excess energy transporting more than 50% of annual load (8)	2
3 **Degree of channel incision (BHR) (Worksheet C-10)**	1.00 – 1.10 (2)	1.11 – 1.30 (4)	1.31 – 1.50 (6)	> 1.50 (8)	3
4 **Stream succession states (Worksheets C-19 and C-10)**	Does not indicate incision or degradation (2)	If BHR > 1.1 and stream type has w/d between 5–10 (4)	If BHR > 1.1 and stream type has w/d less than 5 (6)	(B→G), (C→G), (E→G), (D→G) (8)	2
5 **Confinement (MWR / MWR_{ref}) (Worksheet C-13)**	0.80 – 1.00 (1)	0.30 – 0.79 (2)	0.10 – 0.29 (3)	< 0.10 (4)	3
				Total points	12

Vertical stability for channel incision/degradation (use total points and check stability rating)	Vertical stability category point range for channel incision / degradation			
	Not incised 9 – 11 ☐	**Slightly incised 12 – 18** ☒	**Moderately incised 19 – 27** ☐	**Degradation > 27** ☐

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Worksheet C-23. Channel enlargement prediction summary.

Stream:			Stream Type:		
Location:			Valley Type:		
Observers:			Date:		
Channel enlargement prediction criteria (choose one stability category for each criterion 1–4)	**Channel enlargement prediction categories**				**Selected points (from each row)**
	No increase	**Slight increase**	**Moderate increase**	**Extensive**	
1 **Successional stage shift (Worksheet C-19)**	Stream type at potential, (C→E), (F_b→B), (G→B), (F→B_c), (F→C), (D→C) (2)	(E→C) C → Cw (4)	(G→F), (F→D) (6)	(C→D), (B→G), (D→G), (C→G), (E→G), (C→F) (8)	4
2 Lateral stability (Worksheet C-20)	Stable (2)	Moderately unstable (4)	Unstable (6)	Highly unstable (8)	6
3 **Vertical stability excess deposition/ aggradation (Worksheet C-21)**	No deposition (2)	Moderate deposition (4)	Excess deposition (6)	Aggradation (8)	~~4~~ 6
4 **Vertical stability incision/ degradation (Worksheet C-22)**	Not incised (2)	Slightly incised (4)	Moderately incised (6)	Degradation (8)	4
				Total points	~~18~~ 20
	Category point range				
Channel enlargement prediction (use total points and check stability rating)	**No increase 8 – 10** ☐	**Slight increase 11 – 16** ☐	**Moderate increase 17 – 24** ☑	**Extensive > 24** ☐	

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Worksheet C-24. Overall sediment supply rating determined from individual stability rating categories.

Stream:		Stream Type:	
Location:		Valley Type:	
Observers:		Date:	

Overall sediment supply prediction criteria (choose corresponding points for each criterion 1–5)	Stability rating	Points	Selected points
1 Lateral stability (Worksheet C-20)	Stable	1	~~3~~4
	Mod. unstable	2	
	Unstable	3	
	Highly unstable	4	
2 Vertical stability excess deposition/ aggradation (Worksheet C-21)	No deposition	1	~~3~~3
	Mod. deposition	2	
	Excess deposition	3	
	Aggradation	4	
3 Vertical stability channel incision/ degradation (Worksheet C-22)	Not incised	1	2
	Slightly incised	2	
	Mod. incised	3	
	Degradation	4	
4 Channel enlargement prediction (Worksheet C-23)	No increase	1	3
	Slight increase	2	
	Mod. increase	3	
	Extensive	4	
5 Pfankuch channel stability (Worksheet C-11)	Good: stable	1	2
	Fair: mod unstable	2	
	Poor: unstable	4	
		Total Points	~~12~~ 14

	Category point range			
Overall sediment supply rating (use total points and check stability rating)	Low 5 ☐	Moderate 6 – 10 ☐	High 11 – 15 ☒	Very High 16 – 20 ☐

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Worksheet C-25. Summary of stability condition categories.

Stream:		Location:			
Observers:		Date:	Stream Type: C4	Valley Type: VIII	
Channel Dimension	Mean bankfull depth (ft): 1.4	Mean bankfull width (ft): 23.6	Cross-section area (ft^2): 28	Width of flood-prone area (ft):	Entrenchment ratio: 7.3
Channel Pattern	Mean (range) MWR: 1.5	Lm/W_{bkf}: 4.49	Rc/W_{bkf}: 1.06	Sinuosity: ~~1.34~~ 1.46	
River Profile and Bed Features	Circle: Riffle/pool Step/pool Plane bed Convergence/divergence Dunes/antidunes/smooth bed				
	Max bankfull depth (ft): Riffle 1.4, Pool 3.8	Depth ratio (max/mean): Riffle 1.18, Pool 3.26	Pool to pool spacing: Ratio 58	Slope: Valley: .0009	Average bankfull: 1.2
Level III Stream Stability Indices	Riparian vegetation	Current composition/density: Tulip Poplar	Potential composition/density: Oak Hickory dom. mixed hardwoods	Remarks: Condition, vigor and/or usage of exiting reach:	
	Flow regime: P	Stream size and order: S4(2)	Meander pattern(s): M3	Depositional pattern(s): B5	Debris/channel blockage(s): D3
	Degree of incision (Bank-Height Ratio): 1.15	Degree of incision stability rating: Slightly Inside	Modified Pfankuch stability rating (numeric and adjective rating): 101 \ FAIR		
	Width/depth ratio (W/D): 23	Reference W/D ratio (W/D_{ref}): 21	Width/depth ratio state $(W/D)/(W/D_{ref})$: 1	W/D ratio state stability rating: STABLE	
	Meander Width Ratio (MWR): 1.5	Reference MWR_{ref}: 11.4	Degree of confinement (MWR/MWR_{ref}): 0.13	MWR/MWR_{ref} stability rating: CONFINED	
Bank Erosion Summary	Length of reach studied (ft): 243	Annual streambank erosion rate: 17.85 (tons/yr) 0.074 (tons/yr/ft)	Curve used: MD	Remarks: Strong live tree root protection	
Sediment Capacity (POWERSED)	Sufficent capacity	Insufficient capacity	Remarks: 7 TONS DROPING OUT		
Entrainment/ Competence	Largest particle from bar sample (mm): 70	$\tau = 0.33$	$\tau^* = 0.02$	Existing $depth_{bkf}$: 1.2 / Required $depth_{bkf}$: 0.88	Existing $slope_{bkf}$: 0.006 / Required $slope_{bkf}$: 0.006
Successional Stage Shift	C → C wide → → →			Existing stream state (type): C4	Potential stream state (type): C4
Lateral Stability	Circle: Stable	Moderately unstable	Unstable	Highly unstable	Remarks/causes:
Vertical Stability (Aggradation)	Circle: No deposition	Moderate deposition	Excess deposition	Aggradation	Remarks/causes:
Vertical Stability (Degradation)	Circle: Not incised	Slightly incised	Moderately incised	Degradation	Remarks/causes:
Channel Enlargement	Circle: No increase	Slight increase	Moderate increase	Extensive	Remarks/causes:
Sediment Supply (Channel Source)	Circle: Low	Moderate	High	Very high	Remarks/causes:

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3rd Field Day

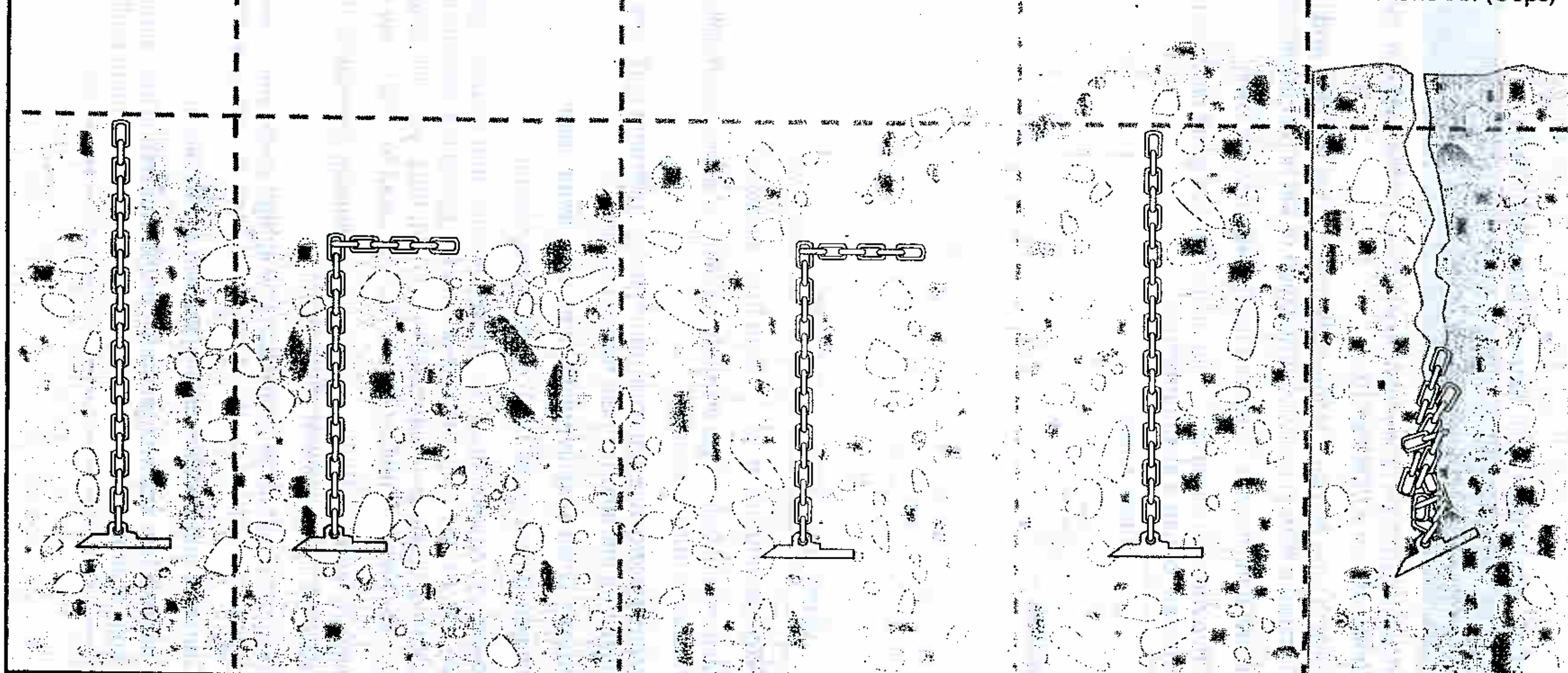
Worksheet C-26. Field form for documenting scour chain results and corresponding bed-elevation changes.

Stream name: Location:

Observers: Stream Type: Valley Type: Date:

		Installation Data (1st Year)				Recovery Data (2nd Year)					
		From cross-section		Particles near chain		Chain recovery				Particles near chain	
		Station (ft)	Elevation (ft)	Largest (mm)	2nd Largest (mm)	Scenario # (1–5)	Scour depth[a] (ft)	Elevation[b] (ft)	Net change[c] (ft)	Largest (mm)	2nd Largest (mm)
Riffle	Chain #1	16.05	97.29	60mm	45						
Riffle	Chain #2	13.0	97.19	42	40						
Glide	Chain #3	25.1	98.08	44	34						
Glide	Chain #4	29.0	98.02	50	36						

Scenario #1. Scenario #2. Scenario #3. Scenario #4. Scenario #5. (Oops)



[a] Scenario 2 or 3. Scenario 2: Enter length of chain exposed. Scenario 3: Enter length of chain exposed then subsequently buried.

[b] Scenario 3 or 4. Scenario 3: Enter elevation of bed at same station @ 2nd year. Scenario 4: Enter depth of material over chain.

[c] Scenario 3: Subtract 1st and 2nd year elevations to calculate net change in bed.

3. Channel Change

Worksheet C-28. Summary of annual data comparisons.

Data Comparison Form

Stream: MAGRUDER Reach: 1

Observers: TEAM 1 Date - Year 1: 2007 Date - Year 2:

		Riffle XS:		Pool XS:		Glide XS:	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Cross-section dimensions	$Width_{BKF}$	23.6		15.1		21.2	
	Mean $depth_{bkf}$	1.2		1.6		1.3	
	Width/depth ratio	19.8		9.4		16.3	
	Cross-sectional $Area_{bkf}$	28.01		24.4		27.2	
	Max $depth_{bkf}$	1.38		3.88		1.79	
Pebble count	D_{35} (mm)	15.08		19		10.45	
	D_{50} (mm)	30.44		34.89		18.02	
	D_{84} (mm)	56.04		82.5		40.32	
Bank Erosion	BEHI rating	High 38.4		Ex 42.2		Low 18.4	
	NBS rating	VL 0.9		Ex 1.43		low 1.0	
	Predicted erosion (ft/yr)	MD 0.23		MD 4.0		MD 0.02	
	Measured erosion (ft/yr)	—		—		—	

	Year 1	Year 2			Year 1	Year 2
Revised Pfankuch Channel Stability Rating	101		Bar Sample	D_{35} (mm)	7.85	
Bank-Height Ratio start: / end:	1.35 / 1.43			D_{50} (mm)	13.77	
Point Bar slope	21.8			D_{84} (mm)	48.02	
Riffle Length/Riffle Width	0.37			D_{100} (mm)	70	
Pool Length/Riffle Width	1.67					
Dimensionless Slope Ratios S_{rif}/S	5.56		Dimensionless Depth Ratios	d_{rif}/d_{bkf}	1.18	
S_{run}/S	9.97			d_{run}/d_{bkf}	1.36	
S_p/S	0.12			d_p/d_{bkf}	3.26	
S_g/S	0.078			d_g/d_{bkf}	1.42	